Engineering Library

NOV 13 1930

"THE ENGINEER," OCTOBER 31, 1930

With METALLURGICAL SUPPLEMENT.

The Engineer.

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Registered as a Newspaper.

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VOL. CL.—No. 3903] LONDON: FRIDAY EVENING, OCTOBER 31, 1930 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E.1, invites TENDERS for:—

2 LOCOMOTIVE BOILERS, Metre Gauge.

Tenders due 18th November, 1930.

Forms of Tender available from the above at a fee of 5s., which will not be returned. 6005

The Institution of Mechanical ENGINEERS.

THOMAS HAWKSLEY LECTURE, 1930.

Professor J. W. GREGORY, LL.D., D.Sc., F.R.S., will deliver the above Lecture on "THE MACHINERY OF THE EARTH," at the Institution, Storey's-gate, Westminster, on FRIDAY, 7th NOVEMBER, 1930, at 8½ p.m. VISITORS ARE INVITED.

The Lecture will be repeated in Glasgow on 13th November, in Birmingham on 18th November, and in Bristol on 20th November. 5993

Cape Technical College.

CAPE TOWN, SOUTH AFRICA.

LECTURER IN ENGINEERING.

APPLICATIONS are INVITED from persons who have had a sound technical training, supplemented by practical experience, preferably in electrical engineering, for the vacant POST of GRADE 1 LECTURER in the Department of Engineering.

Salary according to scale £400 by 25—£500 by 25—£550.

The appointment will be subject to the conditions of service, which, together with College Calendar, may be obtained from the undersigned.

The successful applicant will be expected to assume duty by 2nd February, 1931, and will receive travelling allowance to South Africa and also half-pay for the voyage out.

Applications should be submitted IN DUPLICATE to reach the undersigned by the 17th November, 1930, and should be accompanied by certified copies of testimonials.

Before appointment the production of birth certificate and a satisfactory medical certificate will be required.

This Department of the College undertakes the instruction of apprentices who are preparing for the Preliminary and National Technical Certificates of the Union Department of Education (see College Calendar), and applicants should preferably have had actual teaching experience of a similar nature.

CHALMERS & GUTHRIE (MERCHANTS), Ltd., 9, Idol-lane, London, E.C. 3. 6003

1930 J. No. 643

In the High Court of Justice
Chancery Division
Mr. Justice Maugham
In the matter of J. W. and C. J. PHILLIPS, LTD. (and Reduced)
and
In the matter of the COMPANIES ACT, 1929

Notice is Hereby Given that a PETITION was on the 13th day of October 1930 presented to His Majesty's High Court of Justice for CONFIRMING a REDUCTION of the CAPITAL of the above-named Company from £15,000 to £11,000;

AND NOTICE IS FURTHER GIVEN that the said PETITION is directed to be HEARD before The Honourable Mr. Justice Bennett at the Royal Courts of Justice, Strand, London, on TUESDAY, the 18th day of NOVEMBER 1930. Any creditor or shareholder of the said Company desiring to oppose the making of an Order for the confirmation of the said reduction of capital should appear at the time of hearing in person or by counsel for that purpose. A copy of the said petition will be furnished to any such person requiring the same by the undersigned on payment of the regulated charge for the same.

Dated the 24th day of October, 1930.

STONEHAM and SONS,
108A, Cannon-street, London, E.C.4.
6007 Solicitors for the Company.

County Borough of Reading.

WATERWORKS.

SERVICE RESERVIOR AND WATER TOWER.

TO CONTRACTORS.

It is particularly requested that no person will tender for this contract unless he is already properly qualified by practical skill and experience acquired as a master contractor in the construction of works of a similar or analogous kind, and is in all respects fully competent to perform the contract.

The Corporation of Reading invite TENDERS for the CONSTRUCTION of a RESERVOIR and WATER TOWER adjacent to their existing High-service Reservoir at Park-lane, Reading.

The works included in the contract consist of a Reinforced Concrete Service Reservoir of 20 million gallons capacity, a Reinforced Concrete Water Tower of 200,000 gallons capacity, and Pipe Connections, Drains and other works in accordance with the drawings, general conditions, and specification prepared by the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.

The general conditions, specification, bill of quantities and form of Tender may be obtained, and the drawings may be inspected, at the offices of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

The works are being expedited for the relief of the unemployed, and the contract will be subject to special conditions laid down by the Unemployment Grants Committee.

Tenders, in sealed envelopes, endorsed "Service Reservoir and Water Tower," must be delivered at my office at the Town Hall, Reading, on or before Thursday, the 20th November, 1930.

The Corporation do not bind themselves to accept the lowest or any Tender.

C. S. JOHNSON,
Town Clerk.
October, 1930. F436

The Engineer

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PUBLIC NOTICES

Borough of Bexhill.

ONE 20/22 B.H.P. HORIZONTAL CRUDE OIL ENGINE.

The Corporation are prepared to receive TENDERS for the SUPPLY and ERECTION of ONE 20/22 B.H.P. HORIZONTAL CRUDE OIL ENGINE at their Waterworks at Buckholt.

Form of Tender and conditions of contract, together with further particulars, may be obtained from E. Pollard, A.M.I. Mech. E., Water Engineer, Town Hall, Bexhill-on-Sea.

The Corporation do not bind themselves to accept the lowest or any Tender.

S. J. TAYLOR,
Town Clerk.
Town Hall, Bexhill,
October 28th, 1930. 5998

County Borough of Wallasey.

FILTRATION PLANT FOR OPEN-AIR BATHING POOL NEAR HARRISON-DRIVE, WALLASEY.

TENDERS are INVITED for the SUPPLY and ERECTION of a FILTRATION PLANT capable of dealing with 100,000 gallons of sea water per hour.

A copy of the plan, general conditions, specification, &c., may be obtained from the Borough Engineer's Office, Town Hall, Wallasey, Cheshire, on and after Monday, the 3rd November, 1930, on deposit of One Guinea, which will be refunded on receipt of a bona fide Tender and the return of all documents.

Sealed Tenders, endorsed "Filtration Plant," must be delivered to the undersigned not later than 10 a.m. on the 18th November, 1930.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
GEO. LIVSEY,
Town Clerk.
Town Hall,
Wallasey,
27th October, 1930. 5992

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY CO.

The Directors are prepared to receive up to Noon on Friday, 12th December, TENDERS for the SUPPLY of:—

STEEL MATERIAL FOR BUILDING LOCOMOTIVES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.
Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1,
29th October, 1930. 6004

PROPOSED NEW ERECTING SHOPS, INCHICORE.

The Directors of the Great SOUTHERN RAILWAYS are prepared to receive TENDERS for the above.

Contractors may tender for (a) Builders' Work only; (b) Steelwork only; or for both, but the Directors reserve the right to accept separate Tenders for each section.

Copies of the drawings, specification and bill of quantities may be obtained on and after November 5th, from the Company's Chief Engineer, Westland-row Station, Dublin, C. 5, on payment of Five Pounds, which will be returned on receipt of a bona fide Tender, accompanied by the drawings and bill of quantities fully priced.

Tenders must be on the official form and enclosed in the envelope provided, endorsed "New Erecting Shops, Inchicore," and must reach the undersigned not later than 5 p.m. on Monday, December 1st, 1930.

The Directors do not bind themselves to accept the lowest or any Tender.

H. S. COE, Secretary.
Kingsbridge Station,
Dublin, W. 6, October, 1930. 5996

PUBLIC NOTICES

South Indian Railway COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. SPRING STEEL.
2. WROUGHT IRON.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Spring Steel," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 14th November, 1930.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 2s. 6d. for each copy of the specification.

A. MUIRHEAD,
Managing Director.
91, Petty France,
Westminster, S.W. 1,
29th October, 1930. 6014

County Borough of Swansea.

MAIN DRAINAGE SCHEME.

The Corporation invite APPLICATIONS for the following:—

	Salary per annum.
(A) CIVIL ENGINEERING ASSISTANT	£500
(B) DITTO	£450
(C) TWO JUNIOR ENGINEERING ASSISTANTS	£300 each.

The appointments are temporary, and the probable duration will be at least one year for suitable men, with possible extension. Appointments will be determinable by one month's notice on either side.

QUALIFICATIONS FOR APPOINTMENTS:—Applicants for (A) and (B) should possess either an Engineering Degree or the Assoc. M. Inst. C.E., and must have had experience in the design of large sewerage schemes, sea outfalls, storage tanks, &c. For appointments (C) candidates must be good draughtsmen, surveyors, and levellers.

Applications and copies of testimonials should be sent in as soon as possible and not after Monday, 10th November, 1930, to Mr. J. Richard Heath, Chief Engineer, Guildhall, Swansea. Candidates should apply to the Chief Engineer for list of directions as to the manner of making applications.

H. L. LANG-COATH,
Town Clerk.
Guildhall, Swansea. 5976

Devon County Council.

(NORTHERN AND WESTERN DIVISIONS ROADS RECONSTRUCTION.)

APPLICATIONS are INVITED for the POST of TEMPORARY ASSISTANT ENGINEER.

Salary at the rate of £350 per annum, together with travelling allowance in accordance with the Council's mileage scale whilst on duty.

Applicants must have had good Civil Engineering experience after pupilage, on Road, Railway or Bridge Construction.

Applications, on the official form, with copies of three testimonials of recent date, must reach the undersigned not later than the 10th proximo.

E. M. STONE,
County Surveyor.
9A, High-street,
Barnstaple,
October 24th, 1930. 6011

Resident Engineer Required by a Municipal Corporation in the North of England for the Construction of Sea Wall and other Marine Works, at a salary of £50 per calendar month.

Applicants should not be less than 30 years of age and must have had experience in the supervision and construction, by a contractor, of massive sea walls and other tidal works. They must also be able to survey, level, set out, measure up, and prepare all plans, sections and sketches, &c., required for the complete preparation of the contractor's measurement bills by the Corporation's Quantity Surveyors.

The appointment is expected to extend over two years and will be determinable by one month's notice on either side.

The successful applicant will be required to reside within the district and to act under the direction of the Borough Engineer.

Applications, endorsed "Resident Engineer," stating age, qualifications, experience, references, and date at liberty to take up appointment, to be addressed 5975, The Engineer Office, and delivered before November 7th, 1930. 5975

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PUBLIC NOTICES

The South Indian Railway COMPANY, LIMITED.

An ASSISTANT WORKS MANAGER (PLANNING) is REQUIRED for the Locomotive and Carriage and Wagon Workshops of the above Railway at Trichinopoly.

Applications are invited from candidates who are between the ages of 30 and 40 years, and who, having had a first-class education, have subsequently received training in a large and up-to-date Engineering Workshop. As the candidate appointed will be required, amongst other duties, to be responsible for the Design of Tools, Jigs, and Fixtures, for the Manufacture of which there is in the workshops at Trichinopoly an up-to-date tool-room under a Tool-room Foreman, only those need apply who have had extensive training in Tool-making and Design, and who are capable of Operating and Demonstrating on the various types of machines in a large Engineering Workshop. Candidates should also have specialised in Modern Workshop Management, so far as it appertains to the Planning and Production of Work, and they should have held responsible positions in these branches of workshop management.

The salary of the appointment, which in the first instance will be for three years, will commence at Rupees 750 per month for the first year, rising by annual increments of Rs. 50 per month to Rupees 850 per month for the third year, and in the event of extended service to a maximum of Rupees 1250 per month.

In addition to the above-named salary, overseas allowance will be paid at the rate of £25 per month for the first two years, and £30 per month for the subsequent years.

A first-class passage to India will be provided by the Company, as also, subject to the terms of the agreement, a free passage home in the event of the termination of the service at or before the end of the three years. If the employment is extended beyond that period, the employee will become eligible for certain free passage concessions for himself and his family.

Salary will commence on the date of embarkation for India.

The successf ul candidate will be entitled to the benefits of the Railway Provident Institution.

Forms upon which application must be made may be obtained on written application to Messrs. Robert White and Partners, 3, Victoria-street, London, S.W. 1, the Consulting Engineers to the Company.

A. MUIRHEAD,
Managing Director.

91, Petty France,
Westminster, S.W. 1.
29th October, 1930. 6015

Wakefield Corporation Water-WORKS.
RYBURN DAM.

TEMPORARY ENGINEERING ASSISTANT REQUIRED for one to two years. University training essential. Good Surveyor and Draughtsman. Salary on scale rising from £240 to £300 per annum. Applications, stating age, qualifications and experience of Waterworks Construction, accompanied by copies of two testimonials, to be sent to C. Clemesha Smith, M. Inst. C.E., Town Hall, Wakefield, on or before Tuesday, 18th November.

A. C. ALLIBONE,
6008 Town Clerk.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ENERGETIC YOUNG MAN, Aged between 22 and 25, for a position on a Works requiring personality and tact. Good prospects for successful candidate. Apply in own handwriting, stating age, education and past experience.
Address, P423, The Engineer Office. P423 A

WANTED, GENERAL MANAGER for Steel Bridge and Constructional Works in Midlands with both commercial and technical knowledge. Must have had experience in similar position.
Salary commencing £550 per annum.
Address, giving full particulars, 5983, The Engineer Office. 5983 A

DESIGNERS REQUIRED with Thorough Technical and practical experience in Bus and Coach Chassis.
Address, stating age, full details of experience and salary, P421, The Engineer Office. P421 A

ENGINEER REQUIRED as ASSISTANT to MANAGER in large Masonry and Marble Works in Midlands. Practical experience, mechanical and electrical, essential. Good opportunity for energetic young man with ability to organise production.—Address, P451, The Engineer Office. P451 A

ENGINEER WANTED for Cardboard Box Factory. Used to Stokes and Smiths machines.—Address, stating experience, &c., P448, The Engineer Office. P448 A

FOUNDRY MANAGER REQUIRED. Must be a first-class practical Foundryman, Metallurgist, Engineer and Manager.
Candidates must be thoroughly familiar with Modern Foundry Cost Reducing Plant and Methods, and able to produce first-class Castings for a wide range of duties and weights at low prices.
Address, P422, The Engineer Office. P422 A

REPRESENTATIVE REQUIRED IMMEDIATELY, with connection amongst Publicity Departments of Manufacturing Engineers. State previous experience, terms of employment, when free, &c.—Address, 6016, The Engineer Office. 6016 A

STEEL FOUNDRY MANAGER REQUIRED for Established Foundry producing Heavy and Medium Weight Castings, Marine and Engineering. Progressive man with knowledge of all the best methods to secure output and quality with efficiency. State age, experience and salary.—Address, P424, The Engineer Office. P424 A

WELL-KNOWN INDUSTRIAL ENGINEERING FIRM REQUIRE FIRST-CLASS PRODUCTION ENGINEER; Univ. degree and pub. school educ.; age 28/33; must be experienced in Costing and Production with good firms. Ex. opening for right man.
—Apply, LAURIE and CO., Employment Specialists, 28, Basinghall-street, London, E.C. 2. No preliminary fee. P447 A

WANTED (Temporary Staff), STRUCTURAL STEEL DRAUGHTSMAN. State age, experience, and salary required.—Address, P431, The Engineer Office. P431 A

DRAUGHTSMAN.—Large FIRM of Ironfounders and Engineers REQUIRES the SERVICES of an experienced DRAUGHTSMAN, with knowledge of Colliery and Coal Handling Plant, able to Design and Detail Steel Structures, Elevators, Conveyors, &c.
Full particulars of experience and qualifications, also salary required.
Address, 5984, The Engineer Office. 5984 A

DRAUGHTSMAN REQUIRED in Constructional Engineer's Office. State full experience, age, and salary required.—Address, P434, The Engineer Office. P434 A

Gears
See large advertisement next week.
The Power Plant Co. Ltd
WEST DRAYTON · MIDDLESEX

LEASE OF IMPOSING OFFICES FOR SALE.
33, NORFOLK STREET, STRAND, W.C. 2.

In consequence of the recent amalgamation of "THE ENGINEER" LTD., proprietors of "The Engineer," with MORGAN BROS. (PUBLISHERS) LTD., proprietors of "The Ironmonger" and "The Chemist & Druggist," the offices of the three journals have now been transferred to new and more commodious freehold premises which have been acquired at 28-31, Essex Street, Strand, W.C. 2.

The remainder of the lease, covering a further twenty-five years, of the offices of "The Engineer" at 33, Norfolk Street, Strand, W.C. 2, is in consequence for sale. This particularly well lighted five-storey building has an area of 8,200 sq. ft., and occupies a site at the corner of Norfolk and Howard Streets, adjacent to the Temple Station, whence Westminster and the City may be reached in a few minutes. The building is of modern construction and has a fine and distinctive elevation. It is in good order throughout, and vacant possession can now be had. Rent £1,600. Moderate price. For further particulars apply to:—

WHATLEY, HILL & CO.,
24, Ryder Street, St. James', S.W. 1.

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED, Experienced in the Design of Reinforced Concrete Bunkers, &c., as required for Baum Type Coal Washeries.—Apply, stating age experience and salary required, to NORTONS (TIVIDALE), Ltd., Hecla Works, Tipton, Staffs. 5997 A

FIRST-CLASS DRAUGHTSMAN REQUIRED. Must be conversant with the Design of Road-making and Quarrying Plant, Mechanical Handling and Screening Equipment.
A really proficient man will find this an excellent opening.
State full experience, age and salary required, in confidence.
Address, 5988, The Engineer Office. 5988 A

REQUIRED, ASSISTANT CHIEF DRAUGHTSMAN, must have thorough experience with Design of Steelworks Furnaces and Plant.
Good prospects of advancement to suitable man.
Address, giving age, experience and salary required, P426, The Engineer Office. P426 A

ROLLING MILL DRAUGHTSMAN REQUIRED, Midland District, fully experienced. State age, salary and experience.—Address, 5991, The Engineer Office. 5991 A

LARGE ENGINEERING FIRM in East Midlands REQUIRE a SECTIONAL FOREMAN in their Machine Department, a CHIEF INSPECTOR for the Machine and Erecting Shops, and a RATE-FIXER and TIME STUDY ENGINEER for Fitting, Assembly and Erection.
Address, stating age, full particulars of experience and salary required, P427 The Engineer Office. P427 A

LARGE FIRM Manufacturing Railway Material REQUIRES FOREMAN for their Wheel and Axle Machining and Assembly Shop. Must have first-class knowledge of Machine Tools and Modern Machining Methods. Applicants must send copies of recent testimonials, and state age, experience, and salary required.
Address, P418, The Engineer Office. P418 A

SITUATIONS WANTED

WANTED, by Electrical and Mechanical Engineer, A.M.I.Mech.E., 16 years' experience, TEMPORARY POST up to Six Months; power-house construction preferred. Nominal salary accepted to gain experience before taking up permanent post abroad.—Address, P442, The Engineer Office. P442 B

ADVERTISING MAN SEEKS RESPONSIBLE POSITION, experienced in all classes of engineering publicity.—Address, P425, The Engineer Office. P425 B

CIVIL ENGINEER, Public School, Ex-Service, B.Sc., 6½ years' good experience with public utility company in S. America, SEEKS POSITION at home or abroad.—Address, P420, The Engineer Office. P420 B

ENGINEER (26), G.I. Mech. E., 3 Years Finsbury Tech. College, REQUIRES POST. Four years' experience in structures, maintenance, and layout of plant, &c. Good references.—Address, P428, The Engineer Office. P428 B

ENGINEER (GENERAL), 18 Years in India, REQUIRES to TRAVEL for substantial manufacturer(s) desiring to push good selling lines. Advertiser in direct personal touch with heads of all big houses. Salary and commission basis.—Address, P446, The Engineer Office. P446 B

FOUNDRY MANAGER, Early Disengaged, Will CONSIDER LIKE CAPACITY. Comprehensive experience, grey iron, malleable and non-ferrous; practical metallurgist, full knowledge of modern methods of production, able to meet competitive prices, first-class man in organising, rate fixing, and economical control of labour; sound references, age 39. —Address, P430, The Engineer Office. P430 B

HEAVY MACHINE TOOLS, ALL TYPES.—ENGINEER DESIGNER MANAGER, A.M.I.Mech.E., SEEKS RESPONSIBLE POSITION, home or abroad, representation preferred; twenty years' experience, age 37, sound references.—Address, P439, The Engineer Office P439 B

MECHANICAL ENGINEER, Englishman (32), possessing sound practical and theoretical training (steam, oil, and gas engines, &c.) and valuable all-round technical and commercial experience in the East, SEEKS POST at home or abroad, end of November. Excellent testimonials.—Address, P429, The Engineer Office. P429 B

MECHANICAL ENGINEER (28), Experienced in industrial engineering, with some knowledge of the Continent, DESIRES POST with scope for executive ability and with good prospects.—Address, P432, The Engineer Office. P432 B

POSITION of MANAGER or WORKS MANAGER REQUIRED. Engineer, wide experience management, general engineering and foundry. Excellent references.—Address, P371, The Engineer Office. P371 B

DRAUGHTSMAN (35) DESIRES POST; 15 Years' experience design, erection of industrial constructions, plant and equipment for liquids. Used taking control.—Address, P450, The Engineer Office. P450 B

DRAUGHTSMAN, JUNIOR (Age 23), DESIRES SITUATION; 6 years and 9 months workshop and drawing-office experience; good reference.—Address, P441, The Engineer Office. P441 B

JUNIOR DRAUGHTSMAN, Aged 21, SEEKS ADVANCEMENT, 4 years in engineer's drawing-office, experienced in preparing detail and general arrangement drawings; would specialise if necessary. —Address, P435, The Engineer Office. P435 B

PARTNERSHIPS

WANTED, PARTNERSHIP (Half-share) in Small ELECTRICAL and GENERAL ENGINEERING REPAIRS BUSINESS, Nth. Midland area; if near running stream an advantage; invest £200.—Apply, T. ROPER and CO., Bromsgrove. P449 C

PARTNER WANTED with £400 to SHARE PURCHASE of established ENGINEERING BUSINESS in liquidation, with good connection and cheap; near London.—Reply, BM/STJH, London, W.C. 1. P438 C

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INST. OF MECH. ENGRS.,
INST. OF STRUCTURAL ENGRS.,
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For full particulars and advice apply to:—36, DALE-STREET, LIVERPOOL (Tel., Bank 1118). LONDON OFFICE: 65, CHANCERY-LANE, W.C. 2. Ex.

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Our Advisory Director, who has devoted a lifetime to his subject, will be happy to advise you on any particular point you may raise. Let us get together. Send to-day for our inspiring handbook **"ENGINEERING OPPORTUNITIES," FREE,** post free, and without obligation.

The British Institute of Engineering Technology, 22, Shakespeare House, 29-31, Oxford Street, W. 1.
P331 I

TYPEWRITING.—TESTIMONIALS by Return, 18 copies of one, 1s. 6d.; 50 copies, 2s. 6d.; good paper, neat display.—Miss GREENLAND (E), 40, Park-road, Westcliff-on-Sea. P445 I

FOR HIRE

RICHD. D. BATCHELOR, ARTESIAN WELL ENGINEER (WATER SUPPLIES EXPERT). Largest Boring, Sinking, and Pumping Plant. GRAVESEND CORPORATION TESTED TWO BORINGS to 14,000,000 GALLONS PER DAY (ONE GUARANTEED to 7,000,000).
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AGENCIES

AGENT with Established Connection Amongst steam users REQUIRED by manufacturers for Sale of High-class Vertical Boilers.—Address, 6013, The Engineer Office. 6013 D

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A Seven-Day Journal

High-Pressure Salesmanship.

Some interesting comments were made at the annual dinner of the Institution of Production Engineers last Friday regarding "high-pressure salesmanship" and mass production. Mr. E. W. Hancock suggested that there was still room for another institution, an Institution of Sales Engineers, because no matter how good or cheap production might be, the work done all came to naught if it could not be sold. Whilst we had a superabundance of the type of man who could persuade the local vicar to buy a motor car, what were we doing with regard to pioneer salesmanship, not only at home, but abroad? The result of such efforts might not be manifest for four or five years, but pioneer salesmanship amply repaid itself in time. Mr. J. D. Siddeley said that too much had been heard of mass production. The world had become obsessed with it and was now suffering as a consequence. Over-production had come about through what Mr. Hancock had been glorifying. In other words, there had been too much "high-pressure salesmanship." It had been made too easy to sell because the customer had not been asked to pay for the goods he had taken. Until the world had paid what it owed, we should have to be content with a very quiet period. There could, in any country, be only one or two organisations such as those of Ford, Morris and Austin. For the rest he would prefer to speak of high-class batch production, making the batches as large as the demand called for. High-pressure salesmanship had been made a god in America; it had been overdone, and he felt convinced that the old-fashioned method of this country would prove to be the best in the end.

The Zambesi Bridge and Railway Scheme.

On Friday of last week, October 24th, a contract was signed between the Cleveland Bridge and Engineering Company, Ltd., of Darlington, and the Central Africa Railway Company, Ltd., along with the Trans-Zambesia Railway Company, for the construction of a bridge across the river Zambesi and the making of some 25 miles of railway on the south bank of the river to connect with the railway companies' existing systems. The new bridge, which, it is estimated, will cost close upon one and a-half million pounds, will comprise thirty-three main spans and six approach spans, with a viaduct about 2500ft. in length. The bridge is to be constructed at a point between Mutarara, on the left bank of the river, and Sena, on the right bank. The normal width of the river at this point is 5000ft., which is more than doubled at high flood water. The total length of the new bridge will be about 11,650ft., which will place it among the longest railway bridges in the world, the total length of the bridge and viaduct being over 2½ miles. The construction of the spans will involve the use of over 15,000 tons of steel, and about four and a-half years are to be occupied in the building of the bridge and the construction of the 25 miles of railway, some portion of which will have to be made through the jungle.

The Railplane System of Transportation.

In last week's Seven-day Journal reference was made to the tests recently carried out by Herr Kruckenburg near Hanover with an air-propelled rail car. It may be pointed out, however, that the use of an air-screw for propelling a stream-lined rail car is not new, and that it forms one of the principal features of the George Bennie railplane system of transportation, which we described in our issue of August 23rd, 1929. In Mr. Bennie's system the car is suspended from an overhead track built above the ordinary railway track. During recent months the 462ft. length of railplane track referred to in our article, over the L. and N.E.R. Railway Company's line at Milngrove, near Glasgow, has been completed, and it has enabled full-scale demonstrations of the system to be made, along with static tests and trials of the control and signalling arrangements. It is of interest to learn that a private company in the South of France has now decided to equip 30 kiloms. of track with the Bennie railplane system, and that the preliminary work will shortly be begun. The equipment is to be made in this country, and William Beardmore and Co., Ltd., of Dalmuir, are to construct the railplane cars. Plans for a railplane system to connect the towns of Blackpool and Southport over the river Ribble, by way of Guides House and Hesketh Bank, have been prepared and approved by the Blackpool Corporation, and a Bill in connection with this scheme is to be brought before Parliament. The plans also provide for a road over the river Ribble.

Uniformity of Voltage.

Elsewhere in this issue we publish a brief abstract of the presidential address delivered before the Institution of Electrical Engineers by Mr. Clifford C. Patterson, who dealt, among other things, with the uniformity of electricity supplies, a matter which, in the opinion of the new President, calls for consideration. The manufacturers of electrical appliances, he explained, found it useless to strive for a measure of uniformity which brought no benefit to the public because of electricity supply fluctuations, and he suggested that a maximum distribution curve might be laid down which recognised independent machinery in every district. Just as the manufacturer must regard his present product as inevitably imperfect, but always capable of being more uniform and cheaper through study and research, so the measure of uniformity of electricity should be regarded as a subject of serious research effort and scientific inquiry for the benefit of all concerned. In Mr. Patterson's opinion the uniformity of voltage of the electricity supply has been considerably outstripped by that of the appliances to be used with it, and particularly those which have been scientifically studied. Briefly, the new President's plea is that engineers, whether engaged in the generation of electricity or the generation of articles to be used with it, should recognise where the weapon of research and inquiry can be used in the interests of the public and jointly base further developments and technical policy on the results. It was obvious, Mr. Patterson explained, that those connected with the generation of electricity could do little to increase its effectiveness until the manufacturer did all in his power to increase the effectiveness of his product, and similarly the manufacturer found it useless to strive for a measure of uniformity which brought no benefit to the public because of electricity supply fluctuations. The ±4 per cent. limit was constantly exceeded, and many consumers found that their voltage was considerably above or below the limit, whilst others who did not know anything about voltage found that their electrical apparatus failed to give the desired results.

Cast Iron Research.

On Wednesday last Sir Harold Hartley was elected President of the British Cast Iron Research Association, in succession to Sir Philip Nash. In the short address which he delivered after the customary annual luncheon of the Association, he mentioned that there are over 3000 foundries, ferrous and non-ferrous, in Great Britain, and that the total value of the raw castings must be in the neighbourhood of 40 million pounds sterling per annum, and the output about 3 million tons. Referring to the annual report of the Association, he observed that the application throughout the founding industry of two developments for which the Association was responsible should yield a yearly saving to the trade of at least £200,000. He mentioned also the establishment of a Research Sub-committee on foundry pig irons, and the adoption during the year of a national scheme of foundry education. Referring to the position with regard to research in this country, Sir Harold said he believed that we had an organisation for the practical application of laboratory development to the foundry industry which was unequalled elsewhere. He concluded by calling attention to the fact that in accordance with an agreement made in 1929 with the Department of Scientific and Industrial Research, the Association has to raise an income of £5000 per year before any grant is given, and it is only on a pound per pound basis that financial help will be given in future. An increase of subscriptions was therefore needed. The Association is now spending about £10,000 every year, and next year an increase of 50 per cent. of the income will be necessary. The whole financial position is in the hands of a special committee. In view of the fact that only 12 per cent. of those who ought to support the Association do so, he thought that the objective of every member should to be to secure one new subscriber.

Aircraft Display at Croydon.

An interesting display of civil and Service aircraft, with flying events by the Royal Air Force, took place at the air port of London—Croydon—on Saturday last, when a large company of guests was present, including some of the Dominion Prime Ministers and delegates to the Imperial Conference. In the civil aircraft park there were to be seen representative types of cross-Channel aircraft belonging to the principal European commercial air transport companies. Various constructors of aircraft also showed light aircraft, amphibian machines, and mail carriers. The display in the Service air park included several examples of single-seater fighters and both day and night bombers, also training craft. Much interest was displayed in the three research aircraft, the "Auto-Giro," the "Gugnunc," and the "Pterodactyl." The guests were given an opportunity of inspecting the administration buildings and the hangars. Among the more recent ground lighting developments inspected were the Neon T wind indicator and a transportable floodlight, comprising a searchlight with a 180 deg. drum lens mounted with its generator on a 30 H.P. Crossley Kegresse tractor. In the course of the afternoon the Royal Air Force gave a display of Service flying and aerobatics, the programme including co-ordinated aerobatics by two Gamecock machines, squadron air drill by Hawker-Hart day bombers, and combined aerobatics by a squadron of Siskin single-seater fighters. The three machines from the Research Department above referred to showed what could be done in the way of landing at slow speeds in confined spaces, and the attainment of adequate control at these slow speeds. The excellent performance of the machines in each of the events was made more impressive by the relatively high wind and showery weather which prevailed during the display.

Rationalisation in the Coal Industry.

During the past two years or so there has been a considerable movement on foot in the Lancashire and Cheshire areas for the amalgamation of colliery interests. In 1928 Manchester Collieries, Ltd., was formed for the purpose of amalgamating eleven companies owning between them twenty-two pits and employing 19,300 workpeople. This new company had a capital of £5,500,000. In the early part of this year the Wigan Coal Corporation, with a capital of £1,750,000, was formed to take over the coal interests of Pearson and Knowles, Ltd., and the Wigan Coal and Iron Company, Ltd. Among the undertakings brought together by this amalgamation was one employing 7000 workpeople and another employing 2250. Among other combinations of the past two years there were that of the Garswood Hall and Garswood companies, involving 4000 workers, and that of the Altham Colliery Company, Ltd., John Hargreaves and Co., and George Hargreaves and Co., affecting thirteen pits and 4530 workers. At a meeting in Manchester on Monday an overwhelming majority of the Lancashire and Cheshire coalowners approved of a proposal for the complete amalgamation of all the coal undertakings in the two counties. If the scheme is carried through—and it is stated that its completion is virtually assured—it will result in the creation of a combine with an aggregate capital of about £25,000,000, employing 80,000 workpeople, and having an annual output in the neighbourhood of 15½ million tons of coal. It is understood that the closing of some of the less efficient mines will result from the amalgamation.

The F.B.I. and Fiscal Policy.

The Federation of British Industries is taking immediate steps to formulate constructive proposals following upon the declaration on fiscal policy to which we referred in our issue of October 17th. The President of the Federation has now set up two committees to study the questions arising in connection with that declaration. The first committee, which will be representative of the leading trade associations, will be engaged in considering the type of tariff which can best meet the requirements of British industry, and the best methods of aiming at reciprocal agreements with the Dominions for the promotion of inter-Empire trade. Unless there is general agreement as to the exact type of fiscal system which is required, very serious difficulties, it is held, may have to be faced. It is therefore of great importance that all industries should at the earliest possible moment be given the opportunity of co-ordinating their ideas as to the general principles which should be observed, and the machinery which would be required to put them into effect. The second committee will be engaged in enunciating a complete industrial policy covering questions other than tariffs, namely, national economy, taxation, currency policy, &c. The Federation has already expressed its views on many of these matters in the past, but the Council feels that the time has now arrived for setting forth *in extenso* the reforms which should be undertaken in the interests of industry. Both these committees are being asked to proceed as rapidly as possible with their work.

The R 101 Inquiry.

On Tuesday, Sir John Simon, assisted by Lieut.-Colonel J. T. C. Moore-Brabazon and Professor C. E. Inglis, opened, at the Institution of Civil Engineers, the public inquiry into the loss of the "R 101." The first and second days were occupied by an opening statement by Sir William Jowitt, the Attorney-General. On the non-technical side, Sir William made it clear that although Lord Thomson was anxious to make the voyage to India and back while the Imperial Conference was still sitting in London, none of the vessel's officers at any time suggested to him that it was desirable that the flight to India should be delayed. On the technical side, Sir William indicated that expert examination had failed to reveal any clear-cut and certain cause of the disaster. Attention was, for a time, directed to a cable controlling one of the elevators, which, after the crash, was found to be broken. Microscopic examination, however, established the strong probability that the fracture occurred after, and not before, the crash. The conclusions of the Preliminary Investigation Commission showed that no part of the main structure of the airship broke in the air, and that the explosion which was observed by witnesses of the disaster occurred after the vessel had struck the ground. Regarding the question of the altimeter and the accuracy of its indications, Sir William quoted a report made by Dr. Simpson, Director of the Meteorological Office, to the effect that, following the start of the flight, the barometer dropped and then went up again, and that at the moment of the crash at Beauvais the barometric reading was almost the same as it was at Cardington. It follows, therefore, that the altimeter was reading correctly at the time of the disaster, and that if the navigators had neglected all corrections for change of pressure they would have determined their height correctly.

Spiral Springs for Spring-driven Motors.

By E. C. WADLOW, Ph.D., B.Sc.

SPIRAL springs are widely used to provide the power in motors such as are used for driving clocks, recording instruments, gramophone turntables, and similar small mechanisms. For this purpose they have several advantages over other types of spring. Foremost among these advantages, probably, is the fact that the point of application of the force—the free end of the spring—can be made to move a large number of times in a circle of small diameter, and thus, through the medium of gearing and a suitable governor, can be made to turn a spindle at a fairly uniform speed for a considerable period of time.

Each application has its individual solution. Thus, a motor may be required to give a high torque for a short period, as in a toy engine, or a motor boat, while at the other extreme, as in a clock, the spring is required to give out its energy slowly over a period of many hours.

These and intermediate cases can usually be met by suitable design of spring, gearing and means for releasing the energy at a predetermined rate. Various means of doing the latter are available; for example, the escapement movement in a clock and the absorption governor used on gramophone motors.

For all these applications and for many others it has been possible, using a spiral spring in which to store up energy, to build a compact, reliable and silent running driving unit, which, when run down, can be made to resume work once more by a process no more complicated than that of giving a few turns to a cranked handle.

In what follows the spiral spring is considered mainly from the point of view of the gramophone motor, and the following aspects have been briefly considered:—

(1) The effect of spring dimensions on the torque available.

(2) The effect of spring and barrel dimensions on the number of revolutions of the barrel to unwind a fully wound spring.

(3) The motion of the spring in the barrel during unwinding.

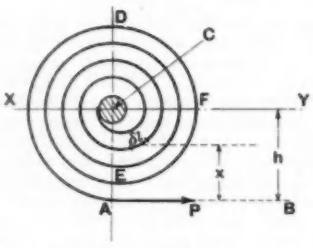
(4) The stresses in the spring.

(5) The mechanical properties of the spring material.

(6) The energy losses occurring in the spring and barrel due to friction and other causes.

(7) The maintenance of constant speed of unwind.

The writer is indebted to the Gramophone Company for permission to publish these notes.



Coils Diagrammatic Only

Fig. 1.

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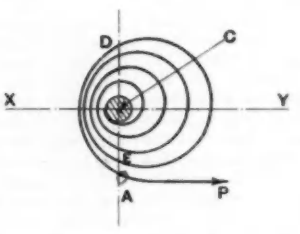

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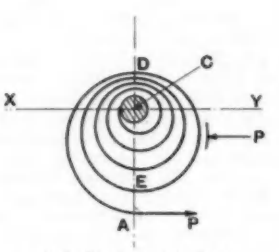
Fig. 2.



Coils Diagrammatic Only

Fig. 3.

Swain Sc

Torque.

The text-book method of calculating the torque which a spiral spring is capable of exerting is usually based on the assumptions that the forces acting on the spring produce only small displacements, that the spring maintains its spiral form, and that the coils never touch one another.

Thus, in Fig. 1, let T be the torque exerted by or on the spring, equivalent to a force P acting at a radius h, C being a fixed centre. Suppose also that the material has been sufficiently overstressed to make it retain the form of a spiral when all external forces are removed, and that none of the coils touch one another.

If, now, a small force P is applied to the free end of the coil in a direction tangential to the outer coil as shown, it will produce a bending moment on any elemental length δl, distant x from A B, equal to

$$M = P x \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The angular winding due to this moment acting on this element is given by

$$\frac{d i}{d l} = \frac{M}{E I}, \text{ or } d i = \frac{P x}{E I} d l \quad . \quad . \quad . \quad (2)$$

where $d i$ is the change in the angle between the two ends of the element $d l$, and I is the moment of inertia of the spring section about the appropriate axis.

Hence the total winding for a very small force P is given by

$$i = \frac{P}{E \cdot I} \int x \cdot d l \cdot \text{radians} \quad . \quad . \quad . \quad (3)$$

For small values of P, such as distort the spring inappreciably from the spiral form,

$$\int x \, d l = h \cdot l \quad . \quad . \quad . \quad . \quad . \quad (4)$$

and by substitution

$$i = \frac{P h l}{E I} \text{ radians} \quad . \quad . \quad . \quad . \quad (5)$$

or

$$T = \frac{E \cdot I \cdot i}{l} \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

where

$$T = P h \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

The equation (6) holds as long as the spring at A remains sensibly normal to A C, no two coils come into contact and the centre of gravity of the whole spring remains at C.

The length of strip from which a gramophone motor spring is made is initially flat, but during the first coiling operation it is overstressed to an extent which gives it a spiral form, when released from all constraint, having about half-a-dozen turns and a diameter over the spiral of about 2ft. or 3ft.

The spring is then placed in a barrel of approximately 3in. diameter, the one end of the spring being anchored to the barrel and the other end to the central spring sleeve. In the unwound condition the spring arranges itself against the inside of the barrel as a closely coiled Archimedian spiral, all the coils being in contact. If, now, the motor is wound up, the spring coils are gradually transferred to the central sleeve, and when fully wound form a closely coiled Archimedian spiral about the sleeve as centre.

In this position the condition of the spring differs from that mentioned above in calculating the available torque in two of the three conditions necessary for the equation to hold. First, the force P is very considerable, and, secondly, the coils are all in contact. In spite of these, however, the third condition, namely, that the centre of gravity of the coil must be on the spindle axis, still obtains.

Since the form of the spring is similar to that of Fig. 1, with the exception of being closely coiled, an equation similar in form to (6) may be used to calculate the torque theoretically possible.

The value of i in (6) is equal to the difference between the angles swept through by the radius vector of the free end of the spiral for the fully wound and completely unrestrained positions respectively. The number of coils in the spring when free from constraint is dependent entirely on the degree of overstressing in the initial coiling and cannot be calculated but must be determined by experiment.

If n_o equals the number of coils in the free spring,

$$i_o = 2 \pi n_o \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

The value of i for the fully wound condition can readily be calculated when the dimensions of the spring and of the sleeve are fixed.

The equation of the spiral will be nearly of the form

$$r = a \theta + b \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

and if d = diameter of sleeve and t = thickness of spring

$$r = \frac{t}{2 \pi} \theta + \left(\frac{d+t}{2}\right) \quad . \quad . \quad . \quad (10)$$

where r and θ are the radius vector and angular position respectively of any point on the spiral.

If l is the length of the spiral, it is sufficiently accurate for thin close-coiled springs to take

$$\frac{d l}{d \theta} = r \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

since $\frac{d r}{d \theta}$ is small in comparison with r.

Therefore

$$l = \frac{t}{2 \pi} \int_o^i \theta \, d \, \theta + \frac{d+t}{2} \int_o^i d \theta \quad . \quad . \quad (12)$$

or

$$l = \frac{t}{4 \pi} i^2 + \frac{d+t}{2} i \quad . \quad . \quad . \quad . \quad (13)$$

from which—

$$i = \frac{-\left(\frac{d+t}{2}\right) + \sqrt{\left(\frac{d+t}{2}\right)^2 + \frac{t l}{\pi}}}{\frac{t}{2 \pi}} \quad . \quad . \quad (14)$$

and the number of turns—

$$n = \frac{-\left(\frac{d+t}{2}\right) + \sqrt{\left(\frac{d+t}{2}\right)^2 + \frac{t l}{\pi}}}{t} \quad . \quad . \quad (15)$$

The torque which the spring is theoretically capable of exerting is—

$$T = \frac{E \cdot I \cdot (i - i_o)}{l} \quad . \quad . \quad . \quad . \quad (16)$$

Owing, however, to friction between the coils, and to other imperfections, the actual torque available for driving purposes is usually much less than that theoretically possible.

For this reason and also to promote smooth working of the spring, considerable attention has to be paid to the lubrication of main springs. The conditions are not altogether unfavourable to satisfactory lubrication, since the rubbing surfaces usually approach one another at a small angle. The rubbing velocity is very small but unfortunately the areas of the surfaces in contact are large.

The lubricant which experience has proved to give most satisfactory results is a simple mixture of castor oil and graphite. By selecting the best grades a lubricant is obtained which will maintain its properties for several years without renewal, which has just the right consistency to stick to the spring as it is wound and unwound, and which does not call for special oil retaining devices to keep it in the barrel.

The film of lubricant is also of appreciable thickness in comparison with the thickness of the spring, and may have a measurable influence on the dimensions of a close coil. When the spring is fully wound, the film thickness may be about 0·003in., which is roughly 12 per cent. of the thickness of spring commonly employed in gramophone motors.

Running Time.

Most spring motor-driven mechanisms are intended to run at constant speed, and the revolutions per minute of the spring barrel are therefore fixed. Let N be this latter quantity. If n is the number of coils in the spring when fully wound, and n_1 the number when the spring is in the barrel, but fully unwound, the running time—

$$R = \frac{n - n_1}{N} \quad . \quad . \quad . \quad . \quad . \quad (17)$$

The value of n may be calculated from (15). If t be the thickness of the spring, l its length, and D the internal diameter of the spring barrel, it can be shown that—

$$n_1 = \frac{\left(\frac{D-t}{2}\right) - \sqrt{\left(\frac{D-t}{2}\right)^2 - \frac{t l}{\pi}}}{t} \quad . \quad . \quad (18)$$

Substituting in (17) the values of n and n_1 from (15) and (18) respectively, and simplifying—

$$R = \frac{-\left(\frac{D+d}{2}\right) + \sqrt{\left(\frac{d+t}{2}\right)^2 + \frac{t l}{\pi}} + \sqrt{\left(\frac{D-t}{2}\right)^2 - \frac{t l}{\pi}}}{N t} \quad . \quad . \quad (19)$$

Assuming N to be fixed by other considerations, there are four variables to be considered, namely, d, D, t, and l. Fixing three of these enables the value of the remaining one which gives the maximum value of R, to be calculated. Thus, if N, d, D, and t are fixed, the greatest running time is obtained when the length of the spring is given by—

$$l = \frac{\pi}{8 t} \left((D - t)^2 - (d + t)^2 \right) \quad . \quad . \quad (20)$$

Very often structural considerations fix the limiting values of D and d. The value of t, however, is generally fixed by the value of the torque required, the torque increasing as the cube of the thickness of the spring. On the other hand, large variations in l, the length of the spring, have very little influence on the torque obtainable, for the reason that in (16) $(i - i_o)$ increases almost as rapidly as l. The torque therefore falls very slowly as l is increased.

With single spring motors of normal design, therefore, the length of spring is the factor having the greatest influence upon the running time.

Often it is impossible to obtain sufficient running time with a single spring, owing to the permissible values of d, D, and t, and resort then has to be made to a combination of two or more spiral springs placed side by side in the same drum and acting in series. By this means, the running time can be increased several times without rendering necessary any increase in spring barrel diameter.

Motion of the Spring in the Barrel.

Owing to the forces acting on the spring, and to the constraint of the barrel, the torque does not fall off uniformly for equal increments of unwind.

When the force P is applied to the spiral spring shown in Fig. 1, the outer coil A D may be regarded as a cantilever, and is throughout its length subject to a shearing force P. The end D is held in position only by the remaining coils, and these are, in a considerable degree, free to move. The portion of the spring between A and B will therefore be displaced in a direction X Y, parallel to A B, by an amount depending on the elasticity of the point D to forces parallel to X Y, in addition to movements due to flexure under the action of bending moments. Similarly, the half coil between D and E will be displaced in the direction X Y by an amount depending on the elasticity of the point E, in addition to movements due to bending forces. The remaining coils are likewise acted upon by both shearing and bending forces.

The spring will therefore be displaced in the direc-

tion X Y relative to the fixed centre C, and the curve, supposing the coils not to be touching, will no longer be a simple spiral, because each semi-coil is not displaced by the same amount.

For the arrangement shown in Fig. 1, there is a further action tending to distort the spring from the true spiral form. The bending moment due to P is greater at D than at E, consequently the change in curvature at D will be greater at E. This will usually result in the spring being distorted in the direction at right angles to X Y and towards A.

The actual total displacement of the spring will therefore be the resultant of these two displacements at right angles to one another.

Each displacement can be demonstrated if a spring similar in shape to that shown in Fig. 1 is available. When a force P is applied as shown, the whole spring will appear to move in the direction X Y after the

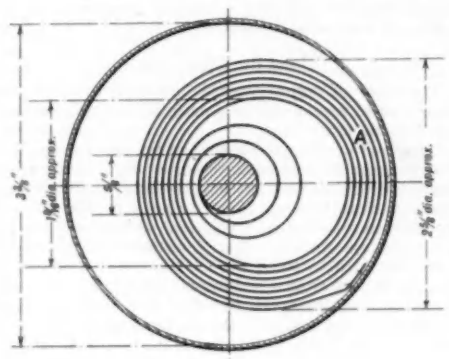


FIG. 4

manner shown in Fig. 2. If a force equal in magnitude to P, but of opposite direction, is applied to the spring at F or D—Fig. 1—the shearing action of the first force is practically nullified, and the spring will be found to have taken up some such form as that illustrated in Fig. 3, indicating generally a slight movement towards A also, which, being small, was previously masked.

When the spring is in the barrel in the fully wound position, neither displacement can occur. If the spring has been wound up very tightly, the torque may fall very rapidly at first as the spring is allowed to unwind, but a steady state is soon reached and the fall becomes more gradual and uniform.

Very soon after the spring begins to unwind, the outer coils cease to be concentric with the sleeve, and move in the direction X Y. As the spiral unwinds the diameter of the outer coil increases, and one by one the inner coils cease to be concentric with the sleeve as they break away to become concentric with the outer coil. At last, the diameter of the outer coil becomes so large that the point F touches the barrel, and the spring has taken up a position similar to that shown in Fig. 4, the main dimensions of which were taken from an actual sample.

For further unwinding, the torque begins to fall off more rapidly again, and finally all the coils become inoperative, and the motor stops.

For a gramophone motor spring in the partly unwound state, the displacement in the direction X Y is many times greater than at right angles to X Y. The centre of gravity of the spring is therefore always nearly on the centre line X Y, which is parallel to the direction of the applied force. As the spring is unwinding, the position of the centre of gravity moves gradually outwards from the spindle centre C, the maximum displacement occurring when the outer coil just touches the barrel in the position shown in Fig. 4. For further unwinding, the position of the centre of gravity retraces its path until, when the motor is run down, it again coincides with the centre of the spindle.

Since any displacement of the centre of gravity occurs mainly in the same direction as that in which the force P is applied, the torque may theoretically be calculated from (16), using appropriate values of i and i_0 for any instant until the coil and the barrel come into contact in the position indicated in Fig. 4. For further unwinding the constraint of the barrel introduces a factor which cannot be satisfactorily allowed for.

STRESSES IN SPIRAL SPRINGS.

It is generally assumed in the usual method of estimating the stresses in spiral springs that the coils never touch one another, and that the spring is left hard right up to the points where it joins the sleeve and the barrel. In practice, the ends of the springs are tempered to enable them to be formed in order that they may be properly attached to the sleeve and barrel, and to ensure that the strip undergoes little change of curvature at the ends, when the spring is in use.

The only way of determining the stresses in a closely coiled spiral spring—assuming that the stresses do not exceed the limit of proportionality for the material—is to find for each elemental length the change in curvature which occurs during winding. This presupposes a knowledge of the shape of the spiral when free. But the shape depends upon the initial set, and is not related to the size of sleeve and barrel with which the spring is to work. The stresses, therefore, cannot readily be determined.

If r_0 = radius of curvature of elemental length δl when the spring is free from any constraint

$$= \frac{1}{i_0}$$

r_1 = radius of curvature of the same element at any degree of wind,

$$= \frac{1}{i_1}$$

t = thickness of spring strip,

E = Youngs modulus for the material,

the stress in the elemental length δl is given by

$$= \frac{E t}{2(r_1 - r_0)} = \frac{E t (i_1 - i_0)}{2} \quad . \quad . \quad . \quad (21)$$

MECHANICAL PROPERTIES OF THE MATERIAL USED FOR SPRINGS.

Spiral springs for motors are usually fairly highly stressed, and it is of little use comparing the properties of two materials without at the same time reviewing the conditions under which they have to work. There is a tendency to introduce steels having higher limits of proportionality and ultimate stress. As far as gramophone motors are concerned, however, uniformity of product is a primary consideration, and is more readily obtained by employing a steel of medium tensile strength and designing accordingly.

A typical material may have the following properties :—

Limit of proportionality	88 tons per sq. in.
Ultimate stress	116 tons per sq. in.
Elongation on 2in.	5 per cent.
Vickers Pyramid Hardness No. ..	560

The value of the limit of proportionality given above is that stress at which a marked curvature of the stress-strain line occurs, and is the stress which determines the subsequent behaviour of the spring.

Measurements made at the National Physical Laboratory indicate that the true limit of proportionality may occur at a very low stress. In some extensometer measurements made there a short time ago the true limit of proportionality was found to occur at a stress lower than 14 tons per square inch. For higher values of stress, also, the stress-strain curves deviated very slightly from the straight line until a stress of 85–90 tons per square inch was reached, when a very marked increase in curvature occurred.

An average value for the modulus of elasticity of spring steel is 28×10^6 lb. per square inch over a stress range of zero to the yield point of about 85 tons per square inch.

ENERGY LOSSES IN THE SPRING BARREL.

The energy losses occurring in the barrel vary greatly from one design to another, and can only be determined experimentally. A convenient method of doing this is as follows :—

The gears are removed from the motor frame and one end of a suitable length of steel wire is soldered on to the periphery of the spring barrel. By turning the winding handle, the wire may be wound on to the periphery of the barrel.

If the motor is firmly held in a vice, the spring may be wound up by applying a pull, through a spring balance, to the free end of the wire. Corresponding readings of pull and of distance moved

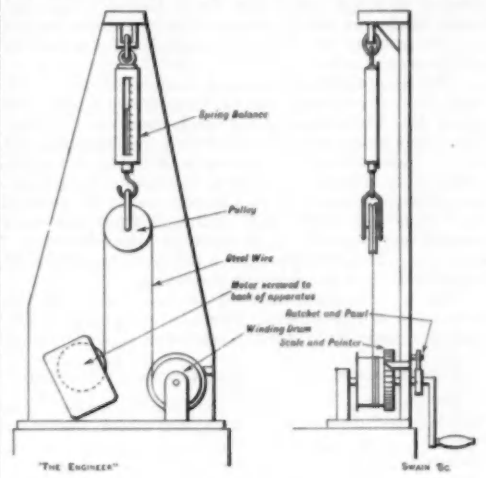


FIG. 5

through by the end of the wire attached to the balance enable the work done in winding the spring to be computed. Similarly, if the process is reversed, and corresponding readings of pull and distance are taken as the spring unwinds, the useful output of energy is directly determined. The above test requires no special apparatus, but it is rather inconvenient. The arrangement shown in Fig. 5 is much more compact and handy.

In Figs. 6 and 7 are shown curves obtained in the manner above described for four different springs. The lines marked oA, oC, oE and oG show the relationship between torque and angle turned through by the barrel during winding. When the springs are fully wound on to the sleeve, and the action is reversed, the torque available is much less than that

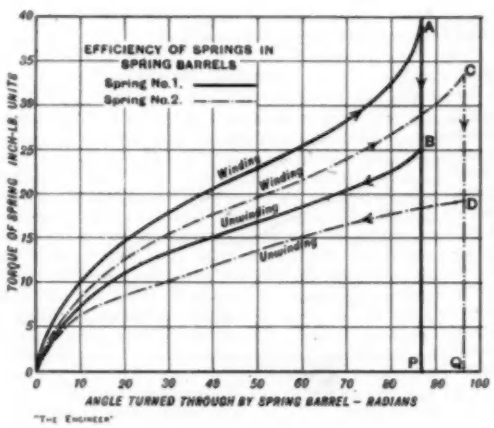


FIG. 6

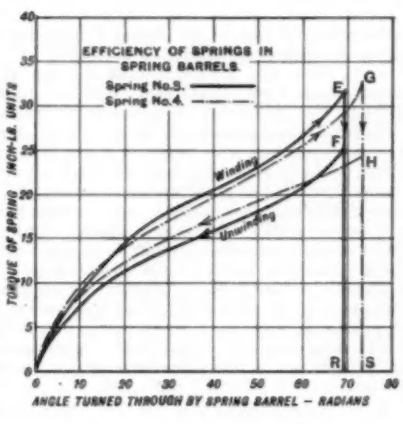


FIG. 7

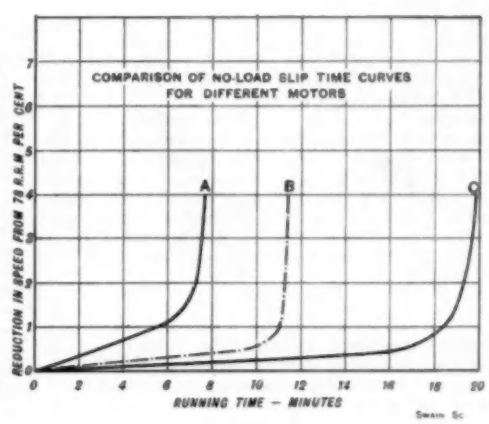


FIG. 8

required to wind, the drop in torque on reversal being given by A B, C D, E F and G H for the respective cases.

Taking Spring No. 1 in Fig. 6 as an example, the efficiency is given by the ratio of the area O B P to the area O A P. The energy lost is given by the area O A B. The efficiency is best determined graphically.

The dimensions of the springs and barrels from which the above curves were obtained are given in Table I. Further particulars, such as efficiency

TABLE I.—*Dimensions of Springs and Barrels Tested.*

Spring No.	Length, in.	Spring width, in.	Thickness, in.	No. of turns in spring when free.	Internal dia. of barrel, in.	Sleeve dia., in.
1	114	1·0	0·026	8½	3⅛	⅜
2	174	1·0	0·022	5½	3⅛	⅜
3	138	¾	0·025	—	2 11/32	13/32
4	114	1·0	0·022	5	2⅛	⅜

NOTE.—Springs No. 1 and No. 2 were tested in barrels of the same design and dimensions.

and calculated maximum torque, are given in Table II. The spring lubricant used in these tests was a mixture of castor oil and graphite.

Table II.—*Results of Tests on Springs Given in Table I.*

Spring No.	Work done winding, in.-lb.	Work done running down, in.-lb.	Efficiency, per cent.	Calculated max. torque, in.-lb.	Max. Torque during winding, in.-lb.	Max. Torque during unwind, in.-lb.
1	149·3	104·6	70·0	41·9	38·5	25·5
2	150·0	97·8	65·2	28·8	33·5	19·3
3	104·5	85·5	81·8	—	31·8	26·0
4	110·2	96·0	87·0	32·2	32·8	24·5

These examples show what variation may be met with in practice, and emphasise the importance of correct design in obtaining, for a desired torque, an easy wind and the lightest motor, since the weight of the spring is usually greater than that of any other single component.

The above efficiencies are calculated from the measured input and output, respectively, and not from the theoretical input and measured output. The calculation of the work which has theoretically to be done to wind the spring is tedious. A certain amount of energy is stored in the spring even in its run down position in the barrel, and this amount has to be calculated and deducted from the total energy required to bring the spring to the fully wound position. The difference gives the work theoretically done each time the motor is wound up.

For a complete analysis, a knowledge of the efficiency of the winding gear is also necessary, but this is outside the scope of these notes.

Maintenance of Constant Speed of Unwind.

So much has been said regarding the variation in driving force which occurs in a spring motor, that some mention of the nature of the speed variation during unwinding which occurs in practice is desirable in order to avoid false impressions being created.

The figures and curves given above relate to gramophone motor springs. It is proposed, therefore, to use results obtained from gramophone motors to illustrate how nearly constant the speed of a spring-driven motor can be maintained by a simple absorption governor.

Three curves are given in Fig. 8. They were obtained by allowing the motors to run down from the fully wound state without a record being played, the speed being measured by means of a stroboscope at very frequent intervals. Curve A is for a motor designed to play for 4½ min., curve B for a motor designed to play for 8¾ min., and curve C for one designed to play for 17½ min.

The total speed variation for each type of motor over the designed playing time is about 0·75 per cent. The fall in torque which occurred in each instance during the designed running time was roughly 50 per cent. of the initial torque.

It is, perhaps, necessary to observe that the majority of makes of gramophone motors on the market at the present time give results much inferior to those shown in Fig. 8—the speed reduction, for corresponding motors being, generally, from two to twelve times as great as shown.

The speed control in the above instances is by means of a centrifugal absorption governor. If the mechanism is slow moving, and an escapement can be employed, as in a clock, a very great accuracy of mean speed over much longer periods is easily obtained. The motion of the spindles is, however, discontinuous. The application of this type of speed control is mainly limited to clocks and watches.

Conclusion.

It will be gathered from the above notes that the theoretical treatment of the spiral spring used in spring motors is not entirely satisfactory. This is due mainly to the large deformations which occur when the spring is under load, to friction, and to other assumptions which do not strictly obtain in practice. In spite of this, however, the formulæ give a very useful approximation, and indicate the magnitude of the effect to be expected by changing one or more of the many variables. A great deal can also be learnt from the simple tests already described. No examination of a design can be complete, however, without some kind of life test. A spring may fail either by breaking or by gradually deforming so that the torque available falls below the minimum allowable, and a slight change in the mechanical properties of the material, or in the thickness of the spring, may produce effects quite out of proportion to the variations causing them.

The official returns rendered to the Electricity Commissioners show that 833 million units of electricity were generated by authorised undertakers in Great Britain during the month of September, 1930, as compared with 755 million units in the corresponding month of 1929, or an increase of 10·3 per cent. During the nine months of 1930 up to the end of September, the total amount of electricity generated by authorised undertakers was 7721 million units as compared with 7291 million units for the corresponding period of 1929, representing an increase of about 5·9 per cent.

Institution of Electrical Engineers.*

Our Outlook on Research.

A glance back, particularly from the inside of industry, must convince an observer of an important change of outlook in respect of research which has taken place within it during the past twenty years, and is still in progress. There has never, I think, been a lack in industry of those who realise how discovery results from research, and who are ready, with all the enterprise at their command, to take up any new discovery and exploit it for the benefit of industry. Such discoveries were, however, regarded as isolated events intruding themselves into the existing art as they knew it. To-day we are realising that the great march of industrial progress depends essentially on research; and British industry is rapidly establishing itself on its own research efforts, and viewing its future with confidence born of the knowledge that it is attracting to itself brilliant research men and is also establishing the conditions under which their activities can effectively react on industry.

The electrical industry has a record in research in comparison with other industries of which it need not be at all ashamed; but that is hardly the point. The real question is, Are we satisfied that the industry is sufficiently dominated by the consciousness that great progress is possible, but only as the result of scientifically inspired inquiry? Do we ask ourselves how much better might we not be if the spirit of anti-empiricism had a firmer grip? A firmer grip of whom? Our research workers? They are not usually content until they find out the reasons for things. Our electricity committees and public authorities who control supply undertakings? I do not know that I dare speculate upon the reception which proposals to spend substantial sums on research would, or do, receive from such committees. I can imagine that some guardians of the ratepayers' money would hold the view that it was not their business to expend it on such objects. Fortunately, this has not been the view of the Electricity Commissioners. What about the attitude of commercial managements? There are some who would blame them; but I find that commercial men usually have an instinctive leaning towards research, if only as a safeguard for the present and an insurance for the future. But commercial men must usually accept the advice of their trusted engineers. What kind of advice do engineers usually give? The capable people whom we meet every day. Not the few to whom we can point as striking examples of men with faith and vision, but the qualified and reliable engineer of sound experience who has earned an honourable reputation for surmounting difficulties and "getting" there somehow. The man of self-reliance and good judgment in factors of safety, who is usually sound and is relied on by commercial managements. He is the man who keeps the industry going. When, as now is increasingly the case, he has the right outlook in research and realises that research has weapons and methods different from the arts of the engineer, he is the most powerful influence for progress in industry.

Now, is there not a danger that the training of engineers and their customary outlook may be inimical to the utilisation of research by industry? The engineer has spent his life saving people expense by his judgment and intuition. Is it not true to say that empiricisms with him are only bad when they are unsuccessful? If an empiricism works, why not leave it alone, when to eliminate it means costly work and a special staff? For him to urge the need for research in his particular domain, is it not belittling his own prescience? Is it not his business to see that there is no unnecessary expense? He is ready perhaps to employ one or two good men on his practical problems, but they must work on problems which he approves and under staff conditions which fit in with those of the remainder of his executive engineers.

Is it not to many such that we must rather look for an improvement in the outlook of the industry generally in regard to research and scientific inquiry into its daily problems? The engineer has a difficult and contradictory task, for he must be at the same time an empiricist when he inspires his production or operative staff, and the reverse in his outlook on the future of his part of the industry. Psychologically, this may prove to be the essence of our problem. Empiricism has an essential place in almost every industrial process, because schedules and specifications can only be based on theory and principles so far as these are known, and the rest must be rule of thumb. Furthermore, the schedules must be such that people who operate them can follow them blindly and empirically. So the atmosphere of production and operation is necessarily empirical, and those who design its framework must assume no outlook but the empirical by those who are to work within it. What incitement, therefore, is there for the directing engineer to turn his thoughts to the importance of finding out the reasons for things and their underlying theories? Seeing that he must carry the constant anxieties and urgencies of the practical difficulties of the moment, is it surprising that a habit of mind grows in the engineer in which research and all that it stands for is forgotten or merely dropped back upon as the last refuge of the destitute, and when it is already too late for research to be of use? I have often noticed in this and other countries the difficulty which many practical administrative engineers have in recognising research problems when connected with their own daily work—or if they do recognise them, seriously to entertain the possibility of organising to cope with them. It often does not seem to engineers that the finding out of the reasons and theories of things is their business or is necessary and worth the expense. The first object of research to them is the discovery of some new product. They are not keen to instigate work which shall explain some of the principles underlying their operations, so that these can be carried on more intelligently, yet their field of activity may bristle with such problems. These problems occur in every part of the industry. In the supply as well as in the manufacturing side of electrical engineering; in selling as well as in designing.

* Address by the President, Mr. Clifford Copland Paterson. Abridged.

Cost of Research.

The cost of experimental research is high, and even that of researches of a more statistical character is not to be minimised.

In a self-contained experimental laboratory it is well to assume that each research worker or experimentalist entails at least two other workers who are not experimentalists. That is to say, the ratio of investigatory technically qualified *personnel* to mechanics, administrative and maintenance *personnel*, is as one-third to two-thirds. I know of laboratories which run nearer to a one to one ratio. In some cases the nature of the work justifies this, but I am confident that as a general rule the most efficient ratio is between 2 and 2·5 to 1. For overall cost of running a laboratory, one is not far out if one multiplies by three the total salaries of the research and experimental people. To reduce this roughly to concrete figures, a self-contained laboratory of total *personnel* of fifty people would have seventeen experimentalists and cost £15,000 per annum, whilst one of 150 would have fifty experimentalists and cost £45,000 per annum, and of 250, eighty-five experimentalists and cost £75,000. I am not here speaking of laboratories which have the responsibility of running the technical processes of a factory, but of those whose contact with such processes is purely investigatory.

It would be appropriate at this time if one could, in turn, review each of the main uses of electricity, with the object of seeing wherein lie its limitations and barriers, and what research has to do in order to remove them, or whether, on the other hand, the obstacles to the improvements which we should like are fundamental and fixed by physical law. There is no indiscretion in such studies. The indiscretion is liable to enter when we base speculations upon them. The time, however, is far too short to attempt such a broad review, even if one felt capable of doing so. I should like, if time allows, to consider two subjects in this way. Heating and lighting are amongst the oldest applications of electricity, but they are still amongst the most important.

Electric Heating.

We can heat, for industrial processes, by the electric arc or by induction, and water can be heated by using it as the conductor, but for the majority of ordinary appliances we still rely upon the "resistance" wire in which energy can be dissipated. For many purposes, and apart from cost, existing materials leave little to be desired, but for other purposes the limitation in the temperature at which they can be run is serious. Industrial furnaces, boiling plates, soldering irons, and all such purposes for which a high temperature is required could be made much more effective if a higher temperature alloy wire could be found. There would not seem to be any fundamental reason against it. At present, the problem is a metallurgical one. The maximum temperature at which satisfactory service can be obtained from existing alloys is determined by their resistance to oxidation. The alloys used are mainly those of nickel and chromium, with or without the addition of other elements. The suitability of these alloys is due to the fact that the oxide layer formed on the surface when they are heated in air is highly protective, and once a certain thickness has formed, further oxidation of the underlying metal proceeds only very slowly. Stainless steel is a familiar example of a similar kind. Stainless steel does not remain untarnished because it is not oxidised, but because it is covered with a very thin, transparent film of a highly protective oxide. This oxide offers little protection, however, when the metal is heated. The protection in the case of nickel-chromium "resistance" alloys is more effective, but oxygen penetrates more rapidly as the temperature is raised. Moreover, the oxide coating tends to crack and flake off each time the wire is heated and cooled, until, finally, the cross section of the wire is seriously reduced. It is clear that deterioration will then proceed at an increasing rate until failure occurs. The suitability of an alloy is thus determined by the protective and adherent properties of the oxide, rather than by the properties of the alloy itself.

The maximum temperature at which any particular alloy is satisfactory also depends upon the diameter of the wire used. The thickness of the protective

layer formed, and the rate at which further penetration proceeds, are independent of the diameter of the wire. In any given period of time a thin wire, therefore, deteriorates more than a thicker one. In large sections such alloys are already being used at temperatures within 200 deg. Cent. of their melting points. With further improvements in the protecting power of the oxide, the melting point itself may become the limiting factor.

How, then, can we hope to develop heating elements which will operate at appreciably higher temperatures? There are other materials besides metals which might be used as resistance elements. Many compounds, such as carbides, nitrides, and silicides of the metals, are good conductors and have very high melting points. Some of these are possible, and compressed rods of silicon carbide are at present used at temperatures up to 1400 deg. Cent. The majority of these compounds oxidise very readily, and all of them are fragile. They are, therefore, only suitable when of large section, and must work with large currents and low voltages. Another alternative is to exclude the air from contact with the heating element. In laboratory apparatus this is done by the use of an inert gas, but this is not feasible for ordinary domestic and industrial purposes. It may be partially effected by embedding the element wire in an impervious refractory, and, although advances along these lines are to be looked for, it must be remembered that it is exceedingly difficult to make a refractory really impervious to the small quantities of gas which are sufficient to cause the wire to deteriorate.

Further advance would therefore appear to lie in the development of alloys of higher melting point, so constituted that the oxide layer formed should be in the highest degree protective. Not only must the oxide resist the diffusion of oxygen, but its physical properties must be such that it will adhere closely to the underlying metal even when subjected to large changes in temperature. Very small changes in the composition of the alloy have already been found to exert a profound influence on the properties of this oxide layer, resulting in an increase of 100 to 200 per cent. in the life of an alloy when used at 1000 deg. Cent. The mechanism of oxidation, and the factors now being studied which affect the protective and adherent properties of oxides, should lead to more radical improvements. At the same time, metallurgical research is being carried out with the object of improving the mechanical and physical properties of alloys used at high temperatures, since the actual strength of the materials used in making electric heating appliances will also become a serious problem when higher temperatures are available.

With wires which would be durable and robust in any size at temperatures upwards of 1200 deg. Cent., and with the evolution which is in progress of better heat-resisting materials and surfaces, it would seem that the designer of heating apparatus should have to his hand the means of fulfilling at will, and economically every requirement for the conversion of electrical energy into either low or high-temperature radiation and in large or small units.

Electric Lighting.†

In the sphere of electric lighting, manufacturers have brought the cost and the simplicity of the product to such a favourable condition that any rival lamp must show an improvement in efficiency or in some other feature of considerable magnitude to result in a breakaway from the present tungsten filament gas-filled lamp.

In the realm of incandescent filament lamps, such a marked advance seems, in the light of present knowledge, highly improbable. In fact, we may say that the luminous efficiency of the modern tungsten filament lamp which reaches 18 lumens per watt in the larger sizes, is not likely to be greatly exceeded as long as we confine ourselves to incandescent filament sources.

Theoretically, indeed, by transforming power directly into light of maximum visibility—that is, into light of wave length 5550 A—about 670 lumens per watt could be obtained. This is, of course, the absolute maximum, and is far above the values obtainable by any means at present known. Moreover, even if such a transformation were actually possible, the light obtained would be monochromatic and of a yellowish-green hue. It would be quite unsuitable for general illumination, for in this light the colours of objects would cease to be observed. The introduction into the source of other wave lengths in order to correct this would, of course, result in a reduction of the efficiency. In order to obtain a perfect colour rendering, we need a source which emits each wave length in the visible region with a relative intensity corresponding to average sunlight. An ideal source which transformed power into light in this manner with no invisible ultra-violet or infra-red radiation, such as is emitted by all known incandescent solids, would produce something of the order of 200 lumens per watt. This, then, may be considered to be the theoretical maximum, if perfect colour rendering is to be obtained.

As is well known, the intensity wave length distribution of the radiation from heated solids may be represented by a curve which rises from small values at short wave lengths to a maximum, and then falls away at the longer wave lengths. The peak occurs at a wave length the value of which is inversely proportional to the absolute temperature.

The sensitivity of the eye rises somewhat similarly from practically zero in the violet at about 4000 A, to a maximum at 5550 A, and then falls to zero again somewhere about 7500 A. It follows that the more nearly the peaks coincide, the greater will be the luminous efficiency of the incandescent solid. An extremely high temperature is found to be necessary in order that the maxima shall actually coincide. This is illustrated by the following table, which gives the lumens per watt corresponding to various temperatures in the case of a black-body radiator. The curves for actual substances are always similar in general shape to that of a black body, the deviations being comparatively small. In the case of tungsten, the deviations are fortunately in a favourable direction so that, although the total power radiated from it is less than that from a black body at the same temperature, a greater proportion is emitted as visible light. The luminous efficiency is thus greater, as will be seen from the third column of Table I.:—

Table I.—*Lumens per Watt.*

Temperature. Deg. K.	Black body.	Tungsten.
2,000	1·7	2·8
2,500	8·4	11·7
3,000	21·2	27·3
3,500	36·7	47·2
4,000	55·5	—
5,000	80·5	—
6,000	93·0	—
7,000	92·7	—
8,000	86·5	—
10,000	68·0	—

It will be seen that the maximum luminous efficiency of a black body occurs at about 6500 deg. K. At lower temperatures, the body radiates more heat than at the optimum, while at higher temperatures it radiates more invisible ultra-violet. No known solids are stable, however, at temperatures nearly so high as this, so that in practice an excess of heat radiation always occurs. But even supposing a solid could be maintained at 6500 deg. K, we should only have 13·9 per cent. of the theoretically greatest possible yield of 670 lumens per watt. Tungsten melts at 3600 deg. K, and at this temperature would give about 50 lumens per watt. In practice, however, various heat losses reduce the efficiency and, owing to the high rate of evaporation near the melting point, the running temperature must be much lower. As a result, the output obtainable in ordinary gas-filled lamps varies between 10 and 18 lumens per watt, depending on the size and life of the filament. This is actually higher than with any other element.

Carbon, which has also a very high melting point, cannot be run at such a high temperature as tungsten, on account of the very high rate of evaporation.

Swinburne, in a paper‡ before the Institution in 1907 discussed the various elements suitable for filaments. At that time there were several missing elements in the periodic table. Now, however, only two remain to be found, one—No. 85—which is a halogen, and the other—No. 87—which is a low melting point alkali metal, probably more reactive than caesium. It follows that neither of these will be of any use as a filament metal. The melting points of the elements can be predicted with considerable accuracy if the corresponding values for their neighbours are known. In this way we find that of the recently discovered elements, masurium (43), illinium (61), hafnium (72), and rhenium (75), only the last has a sufficiently high melting point to be of interest. The predicted value for this element comes out to be 3400 deg. K, or 200 deg. less than that of tungsten. It can therefore be concluded that unless this element has a very much lower rate of evaporation than tungsten, which is extremely doubtful, it also cannot rival tungsten as a filament material. The only remaining possibility, therefore, is the use of high melting point compounds such as carbides. These have been tried, but with, as yet, not very promising results.

The increase in efficiency of the tungsten lamp, due to higher running temperature, has resulted in a concentration of the source. There are two reasons for this—first, a higher temperature means greater intrinsic brilliancy; and, secondly, the filaments of gas-filled lamps have been closely coiled to reduce the conduction of heat by the gas which is introduced to minimise the evaporation. Except, however, for convenience in optical projection and compactness there would not appear to be any merit in a high concentration.

Recently there has been a very healthy move away from objectionable brilliancy by the introduction of a properly diffusing glass bulb for all household lamps, and a tendency in modern fittings design to use diffusing glassware of large surface area and low brilliancy. I sometimes wonder, had we been brought up to larger and more diffuse sources of light, should we have tolerated the present high concentration? Was it not only the great increase in efficiency combined with the skill of the illuminating engineer in toning down the brilliancy, which has caused us to put up with it? Be this as it may, we shall be considering during the next few years what uses there are for gaseous sources of light which are comparable in efficiency with the larger filament lamps, and which are no longer so concentrated.

Gaseous discharge tubes are an interesting study in themselves, but from a utilitarian point of view recent developments have made them even more so, for several of their limitations have recently been removed. Formerly their luminous efficiency was low and they would only operate at several thousand volts. These were minor disadvantages for display and advertising signs, but to-day the hot cathode discharge tube—first tried in America and developed in important respects by Pirani in Berlin—is free from both these restrictions. This type of tube operates on commercial voltages and is capable of an output of from 12 to about 50 lumens per watt, depending on the size of the tube and the gas filling. Distinctly greater efficiencies are thus possible than with incandescent solid radiators. We have, however, still to get full control of the colour, and in considering this we must have a clear grasp of the difference between a gaseous radiator and an incandescent solid radiator.

The essential difference between the radiation from solids and that from gases is that the former is continuous and the latter discontinuous. We have already considered the manner in which the energy is distributed among various wave lengths in the case of the radiation from hot solids. Since here there are no gaps in the distribution curve, the radiation is spoken of as continuous. When, however, gases are rendered luminous by an electrical discharge, their radiation is found to consist of certain wave lengths only, and is therefore called discontinuous. When viewed through a spectroscope, the light from a glowing solid is split up into a continuous strip of light showing the well-known spectrum colours in order from red to violet. That from an electrically excited gas, on the other hand, shows sharp lines. Sometimes groups of an immense number of lines occur close together in such an arrangement as to suggest fluted bands of light; these are called bands. The sharp lines are due to radiation from the gas in the atomic state, while the bands are produced by molecules. Thus the spectrum of mercury vapour, which is monatomic, consists principally of two yellow, a green, and a blue line, while that of nitrogen, the molecules of which are not reduced to the atomic state by the discharge, consists of bands in the red, yellow, green, and blue. An extreme example is carbon monoxide, which gives such a large number of complicated bands that under low dispersion the spectrum might at first sight be thought to be continuous. The intensity distribution is also such that the light gives good colour rendering, and is used for certain colour-matching lamps. Actually, a carbon dioxide filling is used, but this is broken down to the monoxide by the discharge.

Gases can also be excited to luminosity by heat and chemical reactions, a practical example being the batswing burner. The yellow flame gives a continuous spectrum because its luminosity is due to incandescent particles of carbon in the flame, but in the blue part of the flame a faint band spectrum is emitted, the well-known Swan spectrum, which after more than half a century of controversy has recently been shown to be due to molecular carbon.

From the experiments shown, it is clear that if gaseous discharge tubes are to be of value for general illumination purposes, the radiation must consist of the primary colours in more or less correct proportions. Also their luminous efficiency must be high. We have seen that the light given by the carbon-dioxide tube approximates to daylight; but, unfortunately, it only produces from 3 to 5 lumens per watt, and, moreover, for interior lighting daylight is considered to be too cold, a warmer colour being much more desirable. On both counts, the carbon dioxide is thus ruled out for the purpose under consideration.

Changing the current through a gaseous discharge tube does not, in general, produce an appreciable change in the colour; for, although the colour of the light from a filament lamp varies from red to white as the current through it is increased—that is, as the temperature is raised—the colour of the light from a discharge tube depends only on the gases present.

There are, however, two lines along which progress may be made. We can combine two or more high-efficiency tubes to give the required effect, or possibly—but this is much more difficult—combine different gases or vapours in one tube. Thus a sodium and a neon tube combined give a pleasing warm colour, akin to candle light, the colour rendering being similar. The addition of a mercury tube allows anything between this and daylight to be obtained with a fair efficiency.

The approximate luminous output claimed for the hot cathode type of tubes is given in Table II.

Table II.

Type.	Lumens per watt.	Colour of light.
Neon	12 to 35	Red
Neon-mercury	12 to 35	Blue
Sodium	Up to 50	Yellow

With these three tubes, which promise to be satisfactory in other respects, such as length of life, many possibilities are opened up.

Although so much work has been done on the hot cathode type of tube many interesting developments of the original cold cathode tube are also taking place, In spite of the disadvantage that they require high voltages, the cold cathode tubes are particularly suitable for advertisement signs, marking landing positions for aircraft, and various architectural decorative effects.

† This portion of the address was illustrated by experimental demonstrations and cannot be printed as delivered.

‡ *Journal*, I.E.E., 1907.

The colours most easily obtained are orange-red by the use of neon, blue by the introduction of mercury vapour into tubes already containing argon or neon, green by using a yellowish glass with the latter mixture, and yellow by employing helium in a yellow glass. These gases belong to the "rare gas" group, and are chemically inert. When common gases, such as hydrogen, nitrogen, or carbon dioxide, are used, it is found that they rapidly disappear or "clean up" under the action of the discharge. This disappearance is due to a variety of causes, such as chemical action, or to occlusion of the gas in the film of metal which forms on the glass in the vicinity of the electrodes. Thus the original Moore nitrogen or carbon dioxide tubes had to be fitted with replenishing devices which operated whenever the gas pressure fell below a prearranged value. Simpler methods of replenishment are at present in progress of development, permitting various colour effects to be produced.

Another and most remarkable effect is that, under certain conditions which we are only just beginning to understand, the discharge, instead of filling the whole tube as is normally the case, is concentrated into a narrow cord which may occupy only one-fifth of the diameter of the tube. This cord, the intrinsic brilliancy of which is much greater than that of the normal glow, does not remain stationary, but continually wanders in the tube with a peculiar sinuous motion. This is due to attraction and repulsion by charges on the inner surface of the glass. This gives an appearance of motion or of animation to the discharge, but it remains to be seen whether the effect will have many practical applications.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

HIGH-PRESSURE LOCOMOTIVES.

Sir,—I notice in your comment in the current issue of The Engineer, on a letter on the above subject, a reference to the "streamlining" of the L.N.E.R. locomotive No. 10,000. Although it is a fact that wind tunnel experiments were made with the object of determining a front-end shape which should have the effect of throwing the smoke and exhaust steam clear of the driver's line of vision, I should be interested to know whether any authoritative statement has been made to the effect that the general shape of the boiler covering was decided by considerations of air resistance. I am very much inclined to doubt this, particularly in view of the fact that the tender with which the engine was originally provided left between itself and the cab a gap contrary to all conceptions of streamline form. It seems to me that the external shape of the upper parts of the locomotive is simply the shape which the water-tube boiler naturally assumes, and could hardly have been anything different.

Be that as it may, the question may be asked: Is it worth while attempting to make a locomotive of streamline form? It is generally conceded that by far the greatest air resistance which a train encounters is occasioned by a cross wind. If, therefore, the length of the engine is 35ft., and that of the train 1000ft.—not uncommon figures—it is clear that even if the locomotive were so effectively streamlined as to be virtually absent, the advantage would not be great. (In this connection it may be observed that a direct head or tail wind, or a dead calm, are, in the nature of things, comparatively rare occurrences.)

On the subject of British *v.* German locomotive practice, it ought, I think, to be mentioned that the present-day tendency in this country to use three or four cylinders is, in the case of large locomotives, a matter of necessity and not of choice. Owing to loading gauge restrictions, it would be practically impossible to fit a British locomotive with two cylinders of an aggregate capacity equal to that of the three cylinders of a Gresley "Pacific," or the four cylinders of a G.W.R. "King," and, further, it is only the improved balancing possible with more than two cylinders that has permitted the 22-ton and 22½-ton axle loadings of these two classes. W. A. Tuplin.

Huddersfield, October 26th.

RAILWAY PROGRESS.

Sir,—In the article on "The Future of British Railways" in The Engineer of October 17th, you suggest that road competition might be met, economical working improved and better facilities provided for goods trains by decelerating the speed of passenger expresses. Is it not a fact, however, that almost the only reason for travelling by rail as against road services, is greater speed over long distances? Surely the railway companies should rather try to make full use of their one strong point by increasing the speed of all services, goods and passenger, especially in view of the fact that average timings are little faster now than at the end of last century.

Greater speed could be secured in many ways—by-passes to busy stations, as projected by the G.W.R.; greater locomotive power, if necessary, on alternatively lighter trains; ball bearings to stock; attention to streamlining of coaches and engines; continuous brakes to all goods wagons and, possibly, automatic couplings. In connection with the latter it is obvious that something will have to be done in any case owing to the very frequent breakages of draw-gear on the more or less obsolete goods wagons now in use.

A comprehensive scheme of this kind would save the railways from the gradual extinction which threatens, relieve the roads of much congestion, provide employment in many depressed industries and a useful outlet for capital which, at present, seems to be lying idle in the banks.

The Trade Facilities Act might very well be put in operation for something of this kind, as against bolstering up the Russian sugar industry, which our present rulers seem to prefer. J. C. G. Mules.

Bournemouth, October 25th.

FOREIGN TONGUES.

Sir,—As a reader of The Engineer, I happened to read the letter about foreign tongues in your issue of August 15th, 1930. It seems to me that Mr. Hodgson takes it too seriously. He mentions ten years as being necessary to become an efficient technical translator. Of course, I have no definite information about England, but in Holland technical translators will hardly be able to earn their bread by translation only, simply because every engineer graduated at the technical University at Delft is able to speak and write Dutch, English, French and German. Still, it does not take him any extra years of study. Languages are not taught at the university at all. When entering the university at the age of 18 years, the students already possess their knowledge of these languages. These are thoroughly taught at high school. The education system at the university is such that the students have to study apart from Dutch many English, French and German books to be able to pass their examinations successfully. In this way they acquire the knowledge of the special technical part of the languages completely.

So I cannot agree with Mr. Hodgson when he says: "It is impossible in one lifetime to acquire a sound engineering training in two or three subjects and at the same time learn two or more foreign languages thoroughly." Every Dutch engineer from the technical University at Delft is a living proof for the untenability of Mr. Hodgson's thesis. B. L. Voskuil.

Sumatra, September 30th.

Sir,—I have read with great interest your article about "Foreign Tongues" and also the letter which you received from Mr. E. S. Hodgson.

I do not think that the use of Esperanto could be an adequate means of solving the problem of international technical communications, as this practice would involve, practically speaking, first, for instance, the translation from English into Esperanto; second, the translation from Esperanto into French, with the greatest damage to the original text.

My opinion is rather that the solution lies merely in a better and more general learning of foreign languages themselves, which becomes more and more necessary with the progress of international intercourse.

By general and personal experiment I may conclude that, as a basis of the good knowledge of foreign languages, is the careful learning of Latin or Greek, which confers the ability to make up for the obvious incompleteness of technical dictionaries. This is by no means a loss of time, these studies being, as a matter of well-ascertained fact, the best training for further exhaustive scientific learning.

M. Gossieaux,
Engineer, Technical Translator.

Gagny (S-&-O), France,
October 27th.

The German Locomotive Industry.

About three years ago the locomotive firms in Germany approached the Government and the Reich Railway authorities, asking for the grant of orders for steam locomotives for the purpose of assisting in keeping their works in existence for the needs of the country. But the official answer which was received was that the firms must help themselves by putting their own houses in order, as the productive capacity of all the locomotive works combined was too great. Down to 1927, there were 21 locomotive works in existence, and since then nine of them have either been absorbed by the others or been discontinued, while the remaining 12 works still have an output capacity of 3000 locomotives per annum.

In recent months the locomotive firms have again been in negotiation with the Reich railway authorities with the object of securing orders to maintain activity, and the railway authorities have again emphasised the fact that the number of locomotive works, despite the elimination of nine works in the past three years, is still too large to be able to exist on German State orders. On the other hand, the authorities stated that the requirements of the Reich railways will amount to 100 engines per annum during each of the next three years, and that authority has been given by the directors for the purchase of this number. As the distribution of these orders among all the existing works would not afford any one works the possibility of continued existence, the railway authorities submitted that a further step in the matter of rationalisation must take place among the works.

As a result of the negotiations which have taken place between the locomotive firms and the railway authorities, the latter propose to allot exclusively to five or six works at most the contracts for the 300 locomotives which are to be delivered during the next three years. It is about this method of proposed distribution that a dispute has arisen between the leading firms whose activity is substantially devoted to the production of locomotives, and the firms which build engines as an inconsiderable part of their annual turnover.

With the reduction from 21 to 12 firms, the process of concentration in the locomotive industry came to an end, either because the remaining works were unwilling to abandon the construction of locomotives at any price whatever, or because no one was willing to undertake to compensate the makers who would have been eliminated. The stagnation in the matter of concentration—according to the *Frankfurter Zeitung*—was found by the leading firms to be a great disadvantage and they therefore put forward the demand that the Reich railway authorities themselves should decide which particular works appeared to justify their continued existence, while the remaining works should not receive any State railway orders and, therefore, be rendered ripe for capitulation. In this respect the leading firms supported this contention by quoting the example of the wagon construction industry, in which the railway authorities restrict the number of contractors and have thus materially contributed towards overcoming the crisis in this particular branch. At first, the railway authorities refused to play such a part, but they changed their minds in September this year and prepared a draft contract according to which the orders for the 300 locomotives are to be allotted principally to the firms of Henschel, Borsig, Schwartzkopff, Krupp and the Hanover Machinery Works. However, the orders for the first 100 locomotives for the year 1931 have not yet actually been placed, and the negotiations concerning the contracts have not been concluded.

A strong opposition to the proposed method of distribution has been brought forward by those firms which are not to receive any of the orders. The spokesman for the opposition is stated to be the Berlin A.E.G., which characterises the proposal as a presumption on the part of the Reich railways to interfere with the internal conditions of their contractors. The railways, it is contended, should buy locomotives where they are obtainable at low prices, and not create "Court contractors," and through the exclusion of other firms from the list arbitrarily expose them to the loss of prestige, thus causing them prejudice in the open market, especially in the foreign trade.

So far, no details are available concerning the proposed contracts, especially in regard to the prices. In connection with the matter the question of forming an export syndicate has been brought forward—a syndicate which would also consist of the five selected firms, and the necessity for which it said to have been emphasised for the export industry. The sole hindrance, the *Kolnische Zeitung* says, is represented by the A.E.G., which energetically refuses to abandon the construction of locomotives, of which the firm's annual capacity is 150 units. In view of the financial strength of this company, the other firms are not disposed to let matters proceed so far as a struggle with the firm. In return for the suggested abandonment of the construction of steam locomotives, the A.E.G. is said to have been offered the electric locomotive and machinery works of the Maffei-Schwartzkopff Company in Berlin, but the negotiations on this matter failed to mature. The A.E.G. is credited with the intention not to yield to any pressure from any quarter, and will maintain its locomotive department during the next three years in which it is excluded from the Reich railway orders, and in the meantime seek compensation in the export trade.

MANCHESTER ASSOCIATION OF ENGINEERS.

A paper entitled "Stored Energy" was read before members of the Manchester Association of Engineers on Friday, October 24th, by the authors, Messrs. Julius Frith and F. Buckingham, A.M. Inst. C.E. The authors stated that next to the generation of energy, its storage was the most important subject that engineers had to consider, even transcending generation in some cases. Many interesting examples of the use of stored energy were given.

The following is an abstract of the portion of the paper relating to steam storage:—

Steam can be stored merely by putting it into a thermally insulated vessel. This simple method can, however, be improved on by filling the vessel with water and blowing steam into this, till the temperature and pressure of the water reach those of the steam. If the pressure is now lowered, some of the water immediately turns to steam, using the energy stored in the water due to its specific heat. For example, suppose the vessel holds 1000 lb. of water. To raise this to 250 lb. per square inch, which corresponds to a temperature of 406 deg. Fah., and starting at 60 deg. Fah., would require 353,000 B.Th.U.*

Now allow the pressure to fall from 250 lb. to 150 lb. per square inch, corresponding to a temperature of 366 deg. Fah. The loss of water due to evaporation will be about 5 per cent.; the heat in the remaining water will have fallen to 295,000 B.Th.U. The difference, *i.e.*, 58,000 B.Th.U. has gone to make steam. The average total heat between these limits is about 1170 B.Th.U. per pound. Dividing this into 58,000 gives 50 lb. of steam at an average pressure of 200 lb. per square inch. This, in a good steam engine, would give 3 B.H.P. hours.

The vessel could be restored to its original state—full of water at 405 deg. Fah.—electrically, by an engine-driven dynamo. This would take about 25 B.H.P. hours. The efficiency of the transaction works out at about 12 per cent. as a storage of mechanical energy. The vessel would have a capacity of about 19 cubic feet. If it had been simply filled with steam at 250 lb. pressure, the reduction to 150 lb. per square inch would only have liberated about 4 lb. of steam, compared with the 50 lb. mentioned above.

* The specific heat of water varies a little, so these quantities are best obtained from the Steam Tables.

International Motor Exhibition at Olympia.

No. III.*

In the course of our introductory remarks on the Motor Show, which appeared in our issue of October 17th, we referred to its international character, and it may be of interest to place on record the number of cars exhibited by each of the nations. Great Britain naturally stands first with 292, France second with 91, United States of America third with 69, Italy fourth with 36, Belgium fifth with 10; Germany has only four and Spain one. The number of six-cylinder cars shown was 300, four-cylinder cars 104, eight cylinders 88, twelve cylinders seven, and sixteen cylinders two. The maker of the sixteen-cylinder cars is the Cadillac Company, while the makers of the twelve-cylinder cars are the Daimler Company and La Société Anon. des Aeroplanes G. Voisin. In both makes of twelve-cylinder cars the sleeve valve engine is used.

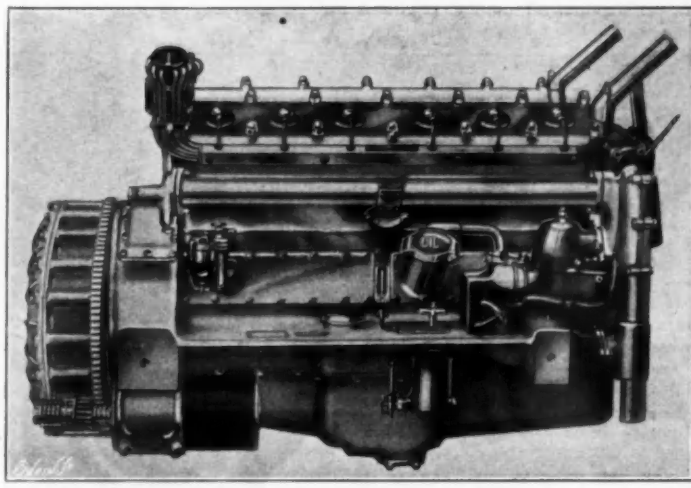


FIG. 23—DOUBLE-SIX, 45-50 H.P. ENGINE—DAIMLER

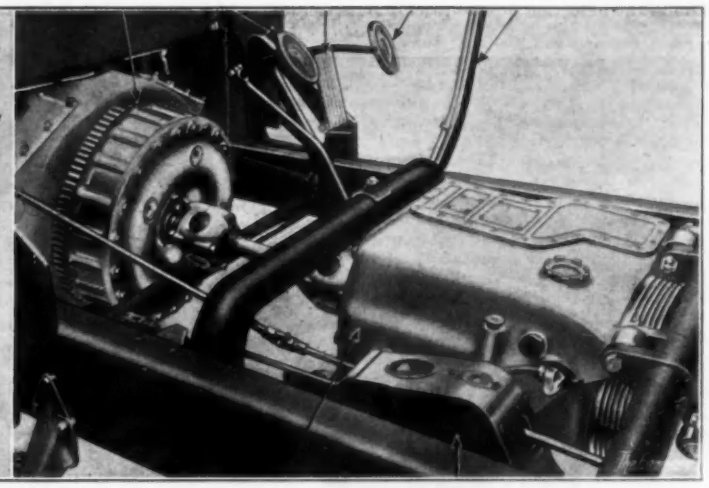


FIG. 24—FLUID FLY-WHEEL AND SELF-CHANGING GEAR-BOX—DAIMLER

ALVIS.

The Alvis Company is re-entering the four-cylinder car market with a car rated at 12–50 horse-power. While this car will resemble in certain features its predecessor of two years ago, the greater part of the car has been re-designed. Two other models, each with six-cylinder engines, were also to be seen at Olympia. The car named the "Silver Eagle," made by the Alvis Company, has a three-carburetter induction system, giving remarkably good acceleration. The 12–50 horse-power four-cylinder car has cylinder dimensions of 69 mm. and 110 mm., and the Treasury rating is 11·8 horse-power. A rotary pump driven by spiral gears from the cam shaft forces oil to the crank shaft bearings, connecting-rods, and timing gears. Coil ignition and a four-speed gear-box with spiral bevel final drive are features of this chassis.

DAIMLER.

The new transmission system incorporating the fluid fly-wheel and a pre-selective four-speed gear-box were the chief features of the Daimler Company's stand. This new system is now standard practice on all this firm's products, namely, the 40–50 horse-power double-six, the 30 horse-power double-six and an entire absence of gear noise when idling or on any gear. Any gear pre-selected by a small control lever on the steering column may be instantly and silently engaged by depressing and releasing a pedal. The latter is a feature which is also in use on another well-known car.

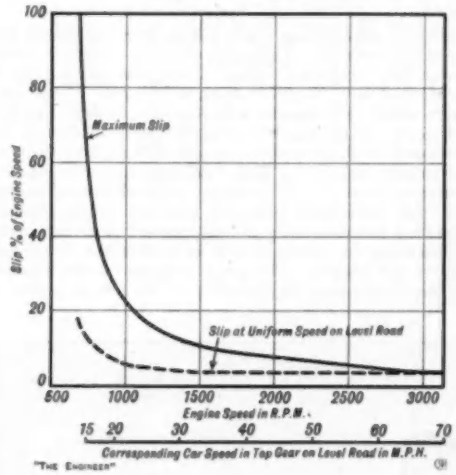


FIG. 25—SLIP DIAGRAM

The diagram which is reproduced herewith—Fig. 25—explains the effect which the Daimler fluid fly-wheel has upon the transmission. This curve shows the lag, or "slip," between the driving and driven members of the fluid fly-wheel at various speeds. The full line is the "slip" under full throttle conditions, while the dotted line shows the normal amount of "slip" existing when the car is travelling at a steady speed on a level road. The important point to note is that while the "slip" at very low engine speeds—on full throttle—can be 100 per cent., as it is when starting, it falls off exceedingly rapidly, but smoothly, with increasing speed. As soon as the car is travelling at a normal speed the "slip" is of the order of 2 per cent. only. In other words, the normal running efficiency of the fluid fly-wheel is 98 per cent. Figs. 23, 24 and 26 show the Daimler 40–50 horse-power double-six engine, the fluid fly-wheel and gear-box and the complete chassis.

RILEY.

Three distinct types of Riley cars were shown. Of them, two have six-cylinder engines, the other being the well-known "Nine." The latter, as in the past, is available in standard or special types. On the special chassis there are two carburetters, duplex Hartford shock-absorbers and a spring steering wheel. The same engine dimensions—60·3 mm. by 95·2 mm., 13·5 H.P.—are employed on both the six-cylinder chassis, but that of the "Stelvio II." car has a longer wheel base, wider track, larger tires, &c. The wheel base of the "Alpine Six" is 9ft. 6in. and the track 4ft., as against the 10ft. and 4ft. 8in. respectively of the "Stelvio II." Improvements found generally throughout the range include stainless steel for external bright parts, grouped chassis lubrication, finger-tip control and new radiators. The 9 H.P. cars also have rear-mounted tanks with vacuum feed, this feature having already been standardised on the "Sixes." "Silent Third" four-speed gear-boxes are fitted throughout the range.

BRITISH MERCEDES-BENZ.

The British Mercédès-Benz exhibits included six and eight-cylinder cars fitted with the Mercédès-Benz-Maybach multi-range gear-box, which gives six speeds forward. Supercharging is adopted on each size of engine, and the eight-cylinder engine is rated at 45–280 horse-power, the bore and stroke being 95 mm. by 135 mm., and the Treasury rating 44·7 horse-power. The six-speed gear-box on the Mercédès-Benz cars is a normal three-speed box to the front end of which is added an auxiliary two-speed gear device, the second pair of gears of which device is utilised as the constant mesh pinions of the normal gear-box. Both the auxiliary gear and the normal three-speed gear are contained in the same

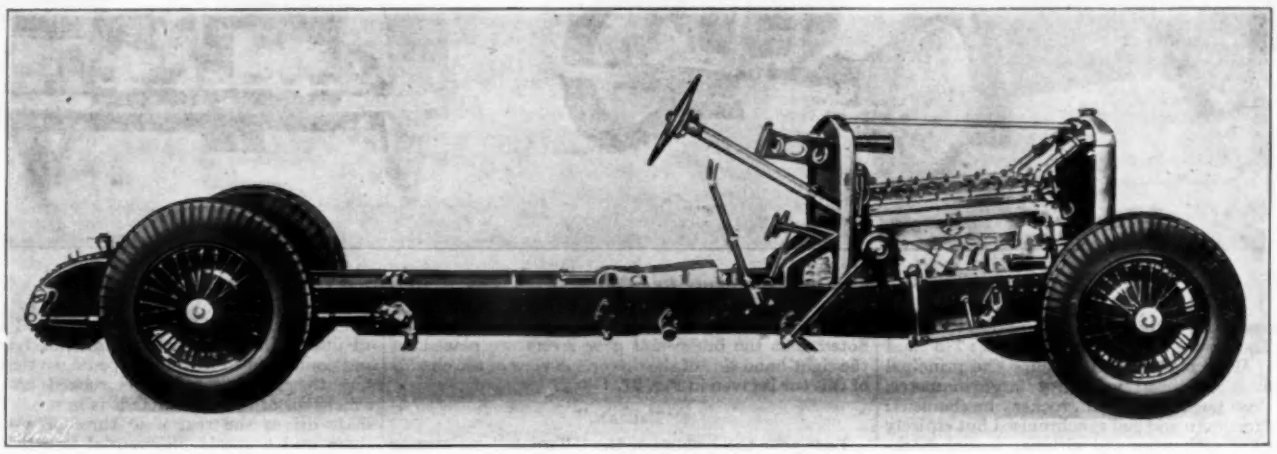


FIG. 26—DOUBLE-SIX, 40-50 H.P. CHASSIS—DAIMLER

* No. II. appeared October 24th.

casing, which has at its front end a bell housing, the transmission gear being built as a unit with the engine. The high and low ratios are operated by means of double dog clutches engaging constant mesh pinions. The control of the gear is by means of a vacuum servo-motor, which obtains its power from a partial vacuum in the induction pipe of the engine, and there is a pre-selector lever above the steering wheel which is moved by the driver, according to whether he desires to utilise the higher or lower ratio of whichever speed is in operation, by the ordinary gear lever, but the change of ratio is brought about when the accelerator pedal is momentarily released, thus allowing the vacuum in the induction pipe to reach the maximum. The main purpose of this system is not, we understand, to increase the maximum speed of the car to any great extent, but to enable the transmission ratio to be adapted to the road conditions and to reduce the engine speed.

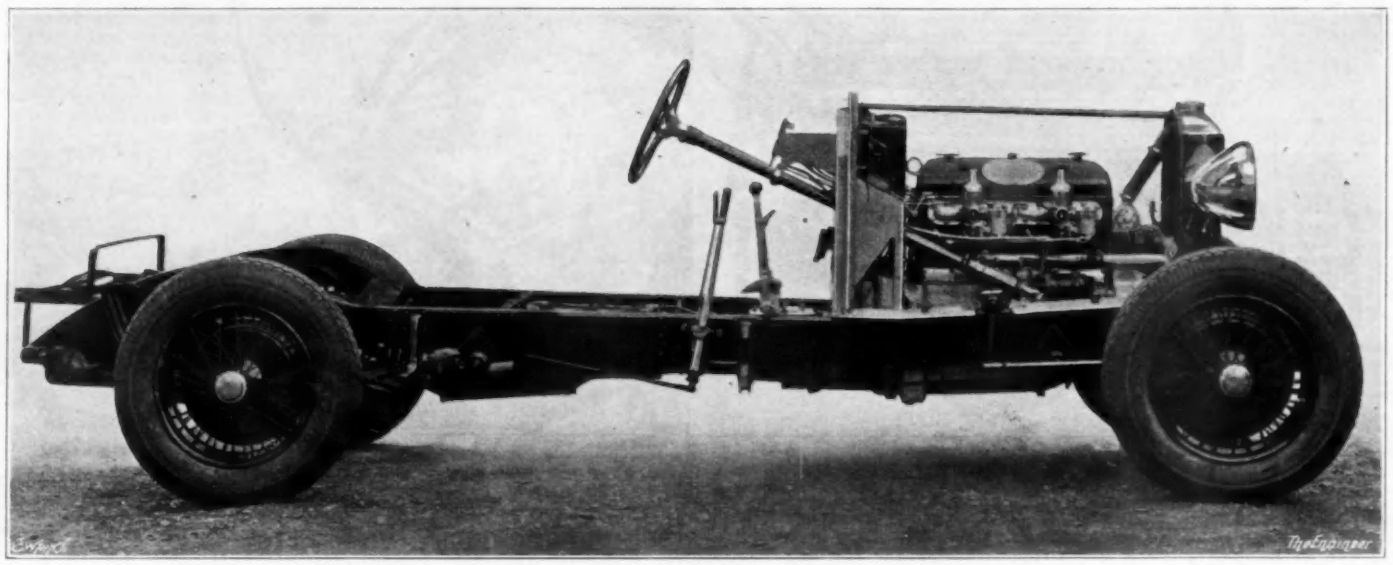


FIG. 27—30 H.P. CHASSIS—"INVICTA"

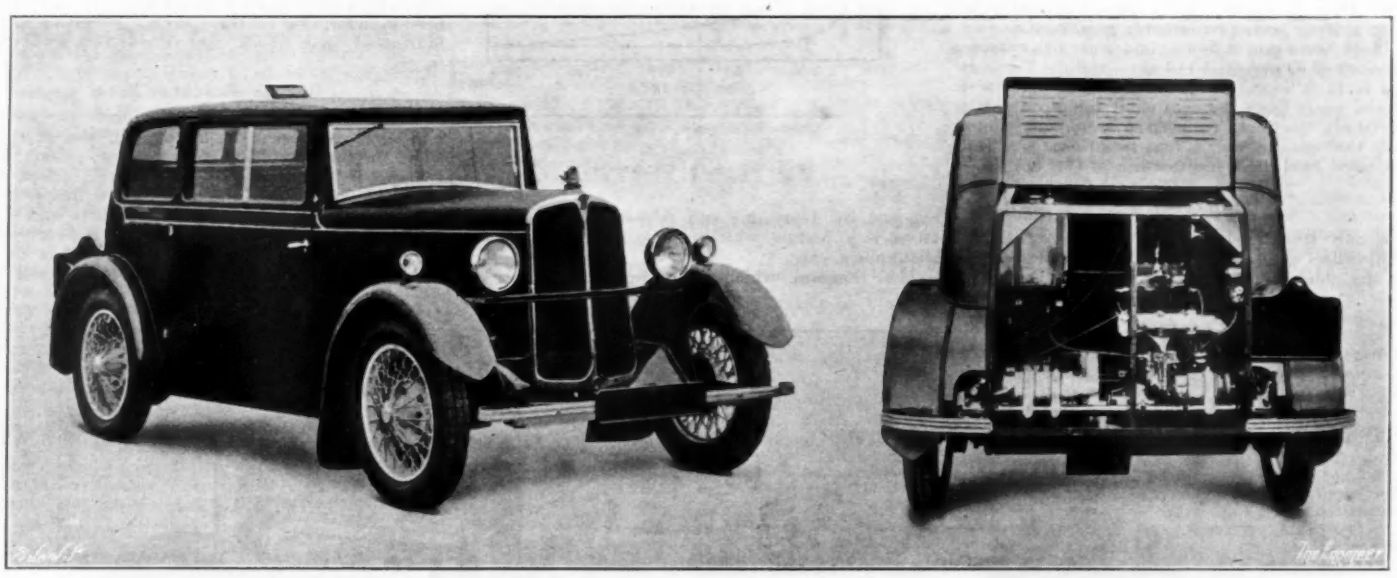
"INVICTA" CARS.

The "Invicta" car, which is made at Cobham, Surrey, has earned for itself a remarkable reputation for exceptional acceleration and tractability. There is nothing freakish about its design. The engine has six cylinders, 88·5 mm. bore and 120·64 mm. stroke, the cubic capacity being 4467 c.c. and the R.A.C. rating 29·1 horse-power. The gear-box has four speeds and a reverse and is of unit construction with the engine. The gear ratios are 3·9 : 5·2 : 7·5 and 11·3 to 1. With regard to the engine the principal features are: Overhead valves of large diameter, operated by push-rods and rocker mechanism; ignition by magneto and coil synchronised but entirely independent of each other and with two sets of sparking plugs; high-pressure forced feed lubrication to the big ends, main bearings and valve rocking shaft gear, and oil pressure controlled by a safety valve and pressure regulator.

Another feature which has much to do with the remarkable accelerating qualities of this engine is the fitting of two carburetters with a balance pipe between them and one starting carburetter controlled from the instrument board. The carburetters are of the S.U. type.

The cooling of the engine is by a large centrifugal pump, honeycomb radiator and thermostat fitted between the cylinder outlet and inlet to the radiator. There is a single dry plate clutch gripped between two friction rings with adjustable clutch stop to facilitate quick changing. The suspension is by long wide semi-elliptic springs, the free ends of which work in sliding trunnions. Double-acting shock absorbers are also fitted.

The main drive to the back axle is taken through springs on the Hotchkiss principle—an arrangement which is claimed to make the car steadier in rounding corners. Metal universal joints running in oil are used exclusively. Lubrication of the chassis parts is by the "autoram" gun. The main fuel supply is contained in a 17-gallon tank at the rear of the car, from which it is drawn to an Autovac tank of 1 gallon capacity on the engine side of the dashboard, and the Autovac tank is combined with an auxiliary tank of 1½ gallons capacity. This auxiliary supply is entirely separate from the main supply, but both are controlled by pull and push-taps on the instrument board. Another precautionary fitting consists of an auxiliary lubricating oil tank, which is controlled by a tap under the bonnet. A special feature of this chassis is the design and construction of the frame, which is upswept over the front and rear axles. It will be noted that the brake and gear levers are placed on the right-hand side of the driver. A view of the chassis of this car is given in Fig. 27.



FIGS. 28 AND 29—SALOON CAR AND REAR VIEW WITH COVER RAISED—"TROJAN"

"TROJAN."

Last year the makers of the "Trojan" car sprung a surprise upon the trade by the introduction of a car with the engine placed at the back. During the year which has elapsed since the introduction of the new design further developments have taken place, and at Olympia the final product was to be seen. The saloon model is illustrated in Figs. 28 and 29. It is of attractive design, with a low overall height and exceptional leg room. It will be seen that the driver sits close up to the screen—which is rendered possible by the fact that there is no engine under the capacious bonnet. The space usually taken up by the motor is thus available for luggage. With the honeycomb radiator at the front the car has a pleasing appearance, but the feature in which engineers are most interested is the power unit and transmission gear, all of which is contained in a steel trunk at the rear of the car, as it was last year. The engine is of the well-known two-stroke "Trojan" design. It has four vertical cylinders, with piston-controlled ports, and a bore and stroke of 65·3 mm. and 117·5 mm., the capacity being 1488 c.c. and the tax £10. The engine is water-cooled and the power from the two-throw crank shaft is transmitted to the rear axle through a three-forward speed, epicyclic gear-box and chain mechanism. The gear ratios are as follows: —Top speed, 45 miles per hour, 3·5 to 1; second speed, 27 m.p.h., 6 to 1, and bottom speed, 11·5 to 1. The gear-box is mounted alongside the engine and is driven directly from the fly-wheel through a number of springs. Within the gear-box are three sun wheels, connected by concentric sleeves to three brake drums. There is also a sun wheel connected to the sprocket shaft and a series of clusters of planet wheels, which are mounted on ball bearings in a cage driven from the engine. Selectors, operated by the gear lever, are coupled by pull rods to the brake bands and clutch mechanism in the gear-box, but they all pass through an intermediate control box mounted on trunnions and connected to the clutch pedal, so that, by depressing the pedal, the box is rocked and disengages whichever of the brake bands is in use. The sprocket shaft drives the rear axle through a double roller chain and a special differential is fitted, which is a frictional device working within a pair of brake drums, one of which is connected to each rear wheel. Surrounding the drums there is a wide contracting band operated by the brake pedal, acting on both wheels with equal force. The hand brake lever controls a separate brake on the sprocket shaft. The rear axle is retained in position by adjustable radius rods, and the whole of the engine and gear-box unit is

carried on a sub-frame bolted to the rear end of the main frame. The whole can be quickly removed. In the rear trunk there are also petrol and oil tanks and

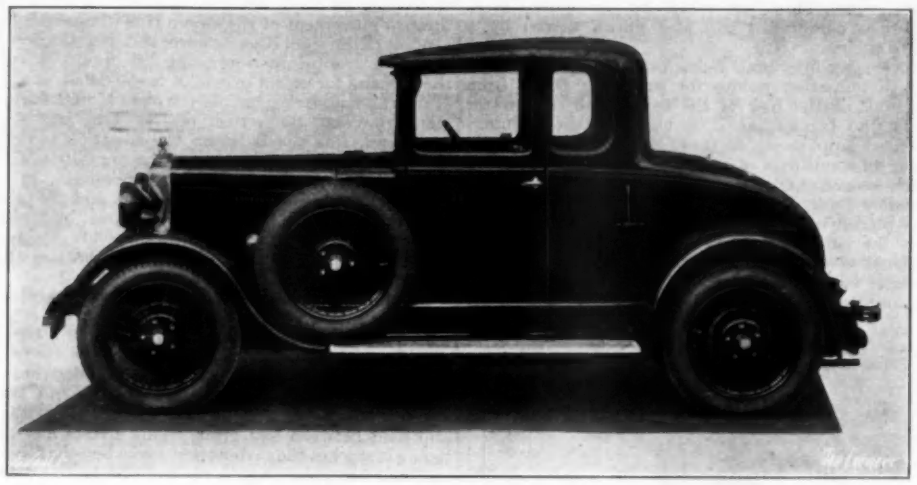


FIG. 30—"MORRIS MAJOR" COUPE—MORRIS

a water reservoir. There is a central gear lever which is operated in the orthodox manner, but as the gearing is epicyclic no crashing of gears is possible and declutching is unnecessary. As regards brakes, it should be pointed out that owing to the rear disposition of the weight of the engine, &c., front wheel brakes are dispensed with. The pipes which connect the radiator with the engine pass underneath the floor boards, and provision is made so that if the water in the engine becomes excessively hot, the water in the working head tank will be automatically returned from an auxiliary head tank. Ignition is by means of a coil and battery and an electric self-starter is provided when desired.

Hillman.

Two departures of outstanding importance were revealed on the Hillman stand. A new eight-cylinder car, known as the "Vortic," has been added to the range. It has a 19·7 horse-power engine of great flexibility, and a feature of the chassis lay-out is the central-change, four-speed gear-box with a silent third speed ratio. In top gear this car has a maximum speed of 70 miles per hour, and in the third speed the maximum speed is 50 miles per hour. Thermostatically-operated radiator shutters and four-wheel Duo-servo brakes are fitted. The 14 horse-power Hillman car remains unaltered.

Rover.

The 10 horse-power Rover car has a lower frame and roomier body than had last year's model. It has a safety glass wind screen and a radiator stone guard. The 2-litre chassis has a "silent-third," gear-box. Rather similar mechanically, but with an engine of 19·3 horse-power, is the new light 20 horse-power car, exhibited as a Weymann coupé with sliding roof.

Morris.

A full range of the Morris firm's cars was shown, including the "Morris Minor," "Morris Cowley," "Morris Major," "Morris Oxford," and the "Morris Isis" saloon. The "Major" is the most recent introduction. This car has a six-cylinder engine,

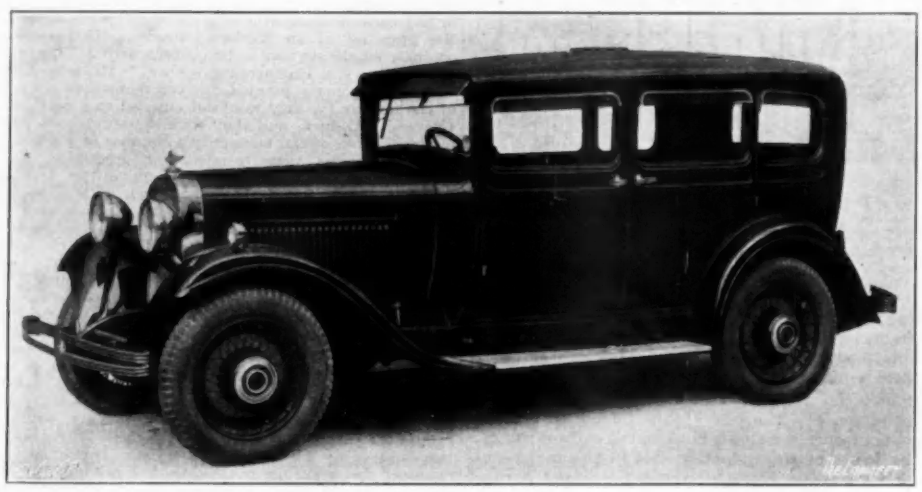


FIG. 31—"MORRIS ISIS" SIX-CYLINDER SALOON—MORRIS

with side valves, full forced feed lubrication, air cleaner and preheater, thermostatically-operated radiator shutters, coil ignition, multiple-plate clutch, three-speed gear-box, with spiral bevel final drive, brakes on all four wheels, shock absorbers, and other refinements, such as a fume-consuming cylinder head. The dimensions of the engine are as follows:—Bore, 63·5 mm.; stroke, 102 mm.; cubic capacity, 1938 c.c., and Treasury rating, 14·9 horse-power. A view of a "Morris Major" Coupé is given in Fig. 30. The well-known "Morris Minor" and "Morris Cowley" cars have four-cylinder engines, but the "Morris Isis" has a powerful six-cylinder engine with a Treasury rating of 17·7 horse-power, the bore and stroke being 69 mm. and 110 mm. The engine of the "Isis" car has overhead valves and camshaft, coil ignition, automatic carburetter, thermostatically-operated shutters, finger-tip steering wheel controls for switches, lights, ignition, &c. A saloon car of this type is illustrated in Fig. 31. The body work provides sufficient accommodation for a family and is upholstered in leather. All the bright parts of Morris cars have now the chromium finish, and the windows are of Triplex glass, and all types, except the baby class, have dipping headlamps.

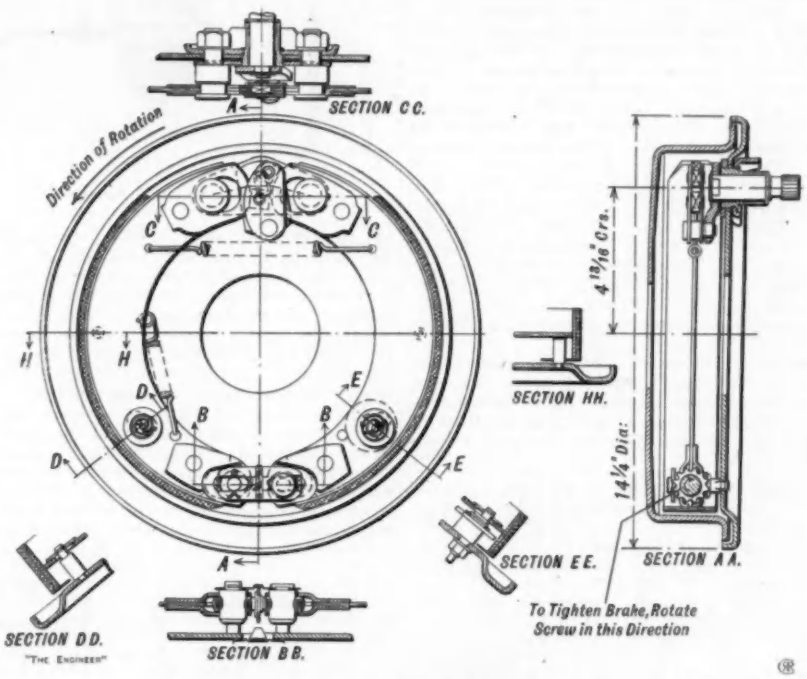


FIG. 32—DUO-SERVO BRAKE—BENDIX-PERROT

Triumph.

The Triumph Company's exhibits included a new six-cylinder car called the "Scorpion," which is claimed to be a luxury car, capable of carrying four adults, with ample leg room and seating accommodation. Although only rated at 11·8 horse-power, the makers claim that this car can achieve a speed of 70 miles per hour. The saloon bodywork is very attractive. There are two wide doors hinged at the front and giving ready access to the seats. The Triumph Company also showed several models of the "super-seven," some of which have magneto and others coil ignition.

Bendix-Perrot Brakes.

Examples of Bendix brakes in various sizes were shown by Bendix-Perrot Brakes, Ltd. The principle of these Duo-servo brakes is unchanged, but improvements and modifications have been effected as regards operation and adjustment. One of the innovations is a cable and conduit control. The cable itself is composed of straight stranded steel, whilst the casing in which it works is made of spirally-wound square spring wire. The square section of the wire has the advantage that it allows the casing to keep a constant radius, upon deflection of the springs and wheels, without pressure on the cable. The assembly is completed by a flexible, weather-proof metal covering. As will be seen from the drawing—Fig. 32—all the operating mechanism is inside the drums; there are no pulleys and no external levers. It is claimed that pedal "chatter" on rough roads is obviated, and—even more important to the owner-driver—there is only one point, the brake cross-shaft, which requires lubrication on the entire four-wheel brake system. It is estimated that, on the average car, the system eliminates ten to twelve lubrication points. Adjustment of the brakes is now very neat and simple. The system, internally, is the same as in the past, but no special tool is now required. Instead, there is a winged nut, attached to a flexible coupling, which enables finger adjustments to be made in a few seconds. The mechanism is totally enclosed.

Singer.

The 10 horse-power Singer car was shown both as a saloon and as a coupé. It has a side valve engine, four-speed gear-box, and a petrol tank mounted in the rear. Other minor changes include a larger oil sump in which the suction pipe and filler are placed near the back, so as to ensure that the pump shall not be starved even when ascending steep hills. Both the six-cylinder car and the super-six are now equipped with thermostatically-controlled, re-designed radiators, while on the smaller chassis the exhaust manifold has been re-arranged, so that the hot gases are led away from the forward end and are well removed from the floorboards. Lighting, throttle, and ignition controls are grouped on the steering wheel.

Miscellaneous Exhibits.

The garage and service equipment section of the Show must have been a revelation to many motorists, judging by their experience of the average public

garage. Some of the appliances exhibited were fascinating to anyone with engineering inclinations. As an example of what up-to-date equipment can do for the motor car user, take a modern car-washing machine as an instance. It consists essentially of a specially designed pump which will deliver water at a pressure of 300 lb. per square inch to a "gun." The gun is capable of giving a stream of water which can be varied at will from a fine mist for use on the body and mudguards, to a strong jet which removes all mud, &c., from the running gear, crank cases, &c. The work is done better and much more quickly than by manual labour. Then, again, for chassis lubrication, pressure greasing is now almost universal, but the hand-operated grease gun is a messy and slow tool to use. Many garages are, therefore, being equipped with power greasing machines, in which the force behind the grease is so great that it overcomes all obstacles. The greasing operation is so rapid that a car can be greased in a fraction of the time taken by hand. Then, again, there are appliances by means of which the decarbonising of the cylinder covers and pistons can be expedited, and valves and cylinders reground almost "while you wait." We have already mentioned the ingeneous brake testing appliances which were exhibited.

Makers of air compressors are finding in the public garage an extensive field for their products. They are not only used for inflating tires, they bring to the service of the motorist such uses as spray painting, engine and radiator cleaning, car drying, car hoisting, &c. The exhibitors under this heading include Harvey, Frost and Co., Ltd., Great Portland-street, London; Romac Motor Accessories, Ltd., Hendon; Kurt Erlach, Ltd., Melior-street, London Bridge; C. Lindley and Co., Englefield-road, London, N. 1; Dowson and Mason Gas Plant Company, Ltd., Levenshulme; Dunlop Rubber Company, Ltd., Birmingham; James Bridger, Ltd., Croydon; George Hatch, Ltd., Upper Thames-street, London; Wayne Tank and Pump Company, Ltd., Sydenham; Brown Brothers, Ltd., Great Eastern-street, London, E.C. 2; Ingersoll-Rand Company, Ltd., Queen Victoria-street, London, E.C. 4; Equipments, Ltd., 159, Great Portland-street, London, W. 1; Newtons of Taunton, Taunton; the Consolidated Pneumatic Tool Company, Ltd., 170, Piccadilly, London, W. 1; Leo Air Compressors, 152, Grosvenor-road, London, S.W. 1; Tecalemit, Ltd., Willesden, N.W. 10; Timson Bros., Moor-street, Birmingham; B.E.N. Patents, Ltd., 92, Tottenham Court-road, London, W.C.; Charles Churchill and Co., Ltd., Leonard-street, London, E.C. 2; Bristol Pneumatic Tools, Ltd., Bristol, and Simkins Engineering Works, Nottingham.

An interesting air-cooled air compressing plant, the principle of which is claimed to be new, was shown by the makers, Romac Motor Accessories, Ltd., The Hyde, Edgware-road, London, N.W. 9, a sectional view of which is given in Fig. 33. It is

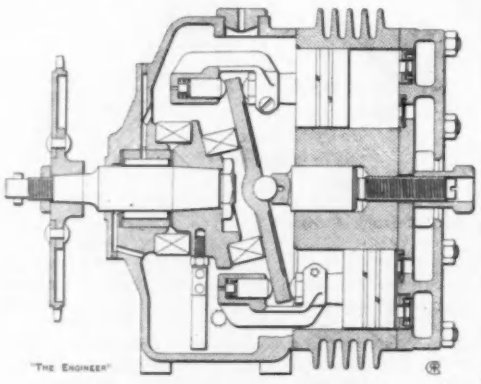


Fig. 33—Air Compressor—Romac

an entirely automatic plant, which is singularly free from noise and vibration. The horizontal compressor has six cylinders, arranged radially, and is capable of working up to 170 lb. pressure per square inch with an output of 7 to 8 cubic feet of air per minute. It is driven by a 1 horse-power electric motor through the medium of chain gearing. The chain gearing drives a spindle on which is a driving block, which, in turn, actuates a swash plate. The oscillating motion obtained in this manner is applied through ball thrust bearings through rods to the aluminium pistons, so that the whole of the back load is evenly distributed. There are no crank shafts, connecting-rods, big or small end bearings or cams. The horizontal movement is entirely disconnected from the rotary, and the air valves are of the disc pattern in an aluminium body. The plant is complete and, with the exception of lubrication, is entirely automatic. As soon as the pressure in the air container reaches a predetermined point, the motor is automatically switched off and *vice versâ*. A pipe leads from the oil trap of the pump to the cut-out, so that every time the motor is switched off a valve opens and permits an impulse of high-pressure air to rush through the oil trap to clear it of any surplus oil which may have accumulated. This arrangement keeps the air line and tank entirely free from oil, foreign matter and water. Although not absolutely necessary, a motor-driven cooling fan, protected by guards, is fixed to the pump. The plant includes a riveted container tank tested hydraulically up to 260 lb. per square inch. This tank is fitted with a safety valve, which blows off at 125 lb. per square inch. A similar compressor was also shown driven by a petrol engine.

Increasing interest is being taken in the manufacture of miniature pumps for supplying petrol from the tank at the rear of the car to the carburetter under the bonnet, as it is claimed that vacuum-operated appliances do not give the best results under all conditions of operation. One of the pumps which we saw at Olympia made by the S.U. Company, Adderley Park, Birmingham, is operated electrically. It is placed under the bonnet and at a higher level than the carburetter. It is shown in Fig. 34, and sectional views of the pump is given in Fig. 35. For power it is connected across the car battery and the consumption of current is said to be approximately

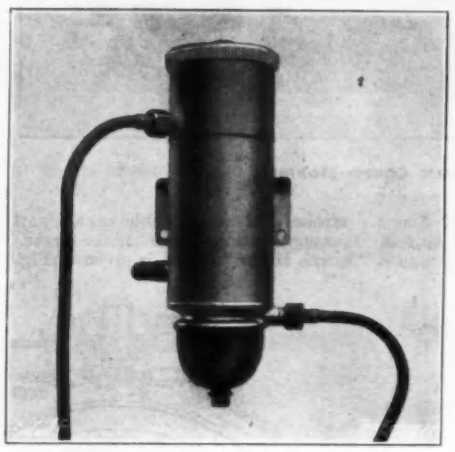


Fig. 34—Petrol Pump—S.U.

$\frac{1}{10}$ ampère-hour on a 12-volt circuit per gallon. Referring to the drawing, it will be observed that the pump has three chambers, the lowest being a glass bowl, into which the petrol enters from the tank, the middle one containing the electrical solenoid mechanism, and the top one being the delivery chamber, from which the petrol flows to the carburetter. The solenoid B, when energised by the passage of electric current, raises the steel plunger C within the central tube, which terminates at its upper end in the chamber A and constitutes the main member of the pump. The plunger contains a simple gravity plate valve, which, on the cessation of the solenoid current, falls to its lowest position by gravity. A similar valve is placed in the screwed part D, which closes the bottom of the tube. Thus, by energising

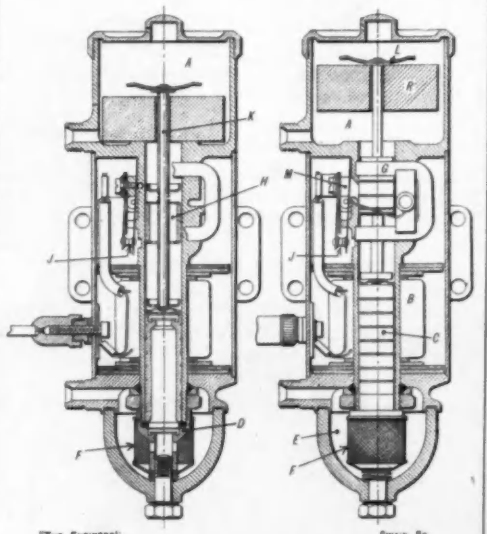


Fig. 35—Arrangement of Petrol Pump—S.U.

and de-energising the solenoid a pumping action is caused, whereby the fuel is drawn up through the inlet into the filter bowl E, and thence through the gauze screen F. The fuel is thus forced up into the upper container, whence it flows to the carburetter.

The heart of the invention lies in the make-and-break mechanism situated round the upper part of the central tube. This comprises two small permanent magnets G, which partially surround the tube, and an iron rocker M, which rocks across the faces of the magnets, making and breaking the solenoid circuit through the pair of points J. The rocking action of the armature is brought about by bringing the iron sleeve H, which is carried on the stem K, opposite to the alternate ends of the magnets, thus short-circuiting the flux at the alternate ends of the two pole faces. This action operates the rocker and by reciprocating the sleeve a make-and-break is obtained at the points J which gives a definite length of stroke depending on the spacing of the magnet arms. The upward movement of the sleeve H is obtained by the contact of the stem K at its lower end with the plunger C, its downward motion being by gravity. When the demand for petrol ceases, or is restricted, the float R rises and, abutting against the plate L on the central stem, prevents the return of the stem and sleeve and, maintains the latter in the situation in which the rocker M is thrown over to the opposite position where the contact points J are separated. In this position the current is entirely cut off and the action of the pump ceases. It will be seen that the rapidity with which the pump operates depends upon the rate at which the fuel is withdrawn from the upper chamber.

More attention is being paid than hitherto to cleansing the air prior to its admission into the engine, and a very neat form of air filter and air silencer was shown by Frank Smith and Co., Elland, Yorks. It fits directly on to the carburetter intake, and the filtering medium is a thick pad of wire and fabric twisted and entangled together, saturated with oil and held between two grids. This arrests any dust before it reaches the carburetter, and when the filtering material becomes clogged up sufficiently to prevent the free passage of the air a whistle, incorporated with the filter, gives audible warning to the driver that the filtering material requires cleaning. For this purpose the material can be readily removed, washed and replaced.

Another new device for supplying carburetters with a constant amount of petrol was shown by Amalgamated Carburetters, Ltd., Perry Barr, Birmingham. This is a small mechanically-operated pump, in which a diaphragm is actuated, either by a plunger driven off the cam shaft or by a rocker arm. The makers state that this pump has been thoroughly tested and that it is very reliable.

Ross Courtney and Co., Ltd., London, had some interesting appliances on view. We were particularly interested in the thief-proof "petromag" lock tap, which prevents cars being driven away without the owners' consent. As its name indicates, the engine cannot be started without the necessary key, which automatically shuts off the petrol and switches off the magneto.

(To be continued.)

SIXTY YEARS AGO.

For a considerable period of their history engineers had to struggle on as best they could under the knowledge that in the eyes of many people their occupation in life constituted a trade, a calling, or a craft, but in no circumstances could it be admitted to the dignity of being a profession. The Church, the Law, the Army and Navy and the practice of Medicine—these were the only occupations which could rightly be called professions, in the opinion, at least, of ministers, lawyers, military and naval officers and doctors. The "professions" were supported in their exclusiveness by the universities. Very grudgingly was it admitted that engineering was a fit subject for university instruction. Glasgow University, to its unending credit, was one of the first, if not the very first, of such establishments to welcome engineers within its halls. It had been kind to James Watt in the days of his adversity, and something over a hundred years later it established "a systematic course of study and examinations in the various branches of science bearing on engineering." Thus, tardily, was engineering admitted to academic status. It should not, however, be assumed that the doors of recognition were opened full-wide straight away. The "systematic course of study and examination," if successfully pursued, was not followed, as it was in the case of those studying for the "professions," by the granting of an academic degree. The successful engineer candidate had to be content with a "Certificate of Proficiency in Engineering Science." Holders of these certificates were not permitted to call themselves graduates of the university, they were not entitled to a seat on the University Council, and they were debarred from voting in the election of the university's Member of Parliament. These privileges were reserved for graduates in the "professions." In Macquhorn Rankine the depressed engineer classes found their champion, as well as their professor. From a note in our issue of November 4th, 1870, we learn that he had been active in their interests at a recent meeting of the General Council. He argued that evil consequences to the interests and reputation of the University would follow if it delayed much longer to grant to the holders of the certificate of proficiency in engineering science the academic status to which the nature and extent of their studies entitled them. With what must have been a considerable amount of daring, he proposed that on the successful completion of their studies, they should be created Bachelors of Science. Still more daring he even spoke of the possibility that engineers might, in their own line of study, aspire to receive the dignity of a doctorate of science. Alternatively, the University might institute a new degree specially reserved for granting to engineering graduands. For the creation of such a degree the Unversity would, however, need to obtain additional powers from the Crown, whereas its existing powers were already sufficient to permit it to award to engineers the degrees of B.Sc. and D.Sc. The Council remitted the question to a committee. In the fulness of time, Rankine had his wishes granted, and engineering, academically at least, became one of the recognised professions.

Railway and Road Matters.

THE mover of the Address from the House of Commons at the reopening of Parliament on Tuesday last was Mr. H. C. Charleton, the Member for Leeds South. Mr. Charleton is an engine-driver and one of the Members supported by the National Union of Railwaymen. He is a member of the Automatic Train Control Committee.

THE first of the new oil-electric cars manufactured by the Westinghouse Company for the Erie Railway has been put into service. The car is equipped with two heavy-oil engines, driving Westinghouse generators, and is capable of a maximum speed of 85 miles an hour. It is said to be able to run 1000 miles without refueling.

A DELIGHTFUL personality has just retired from the French railway service. We refer to Monsieur A. Moutier, the Ingénieur-en-Chef des Services Techniques of the Chemin de fer du Nord. Monsieur Moutier was a reporter to the Rome—1922—and London—1925—meetings of the International Railway Congress, has been President of the Société des Ingénieurs Civils, and is one of the inventors of the M.D.M. system of route signalling much used on French railways.

ENGINEERING experts in Spain are keenly discussing schemes for the proposed tunnel under the Straits of Gibraltar. A report describing the results of preliminary borings made at Tarifa, near Gibraltar, has just been published. Excavations at that place have resulted, it is stated, in the discovery of rock, at a depth of 800ft., which is impervious to water. A tunnel, it is asserted, could be bored through it safely. Similar exploratory boring is shortly to begin on the Morocco shore. The route of the tunnel at present proposed would be one of 8 miles. The cost of the investigations is being provided by the Spanish Government.

DISTANT signals are usually referred to, even in such official documents as the railway companies' rule books, as indicating "danger." That is a misnomer; only stop signals can be spoken of as being at "danger," and distant signals are not stop signals. They repeat the condition of the stop signals that are being approached, and thus are, as called on the Underground railways, repeater signals. The correct name for the "on" indication of a distant signal is "warning," and when "off" it is at "clear." These are the names laid down in the Ministry of Transport requirements for new railways and are always used now in the accident reports of the Inspecting Officers.

A NEW table—a sequel to the Charfield disaster of October 13th, 1928—is presented in the Railway Returns for 1929. It shows how many passenger-carrying vehicles are lighted by gas and by electricity. The former number 21,981 and the latter total 23,476. The percentages of the electrically lighted of the four larger companies are:—Southern, 74·51; London, Midland and Scottish, 55·70; London and North-Eastern, 42·95, and Great Western, 39·29. It appears that there were on December 31st last 253 coaches that were still lighted by oil lamps. Of these the L. and N.E. had 205 and the L.M. and S. had 48. These figures are exclusive of the electrically operated stock, which total 5202, and of which 569 are on the Metropolitan and 2072 on the Metropolitan District and its allied tube railway, the Liverpool Overhead and the Mersey.

THE Great Western Company's system of cab-signalling was introduced in 1906, and, after a trial on the Henley branch, was put into use throughout the Fairford line. After a long interval, it was installed, with the addition of automatic train control, in the London area and subsequently extended to Reading. After the Charfield disaster of October 13th, 1928, on the London, Midland and Scottish Railway, it was announced that a big further extension had been ordered, and in this column of our issue of January 4th, 1929, we were able to say that the new area to be covered extended from Reading to Swindon, Didcot to Oxford, and Old Oak Common to High Wycombe, It provided for 372 track miles and called for the equipment of 334 locomotives. It is now intimated that the greater part of the main line is to be similarly treated, *i.e.*, Reading to Plymouth, Swindon to Taunton, Swindon to Swansea—*viâ* Badminton and *viâ* Gloucester—High Wycombe to Wolverhampton, Oxford to Banbury, Oxford to Worcester, Birmingham to Gloucester, Wolverhampton to Newport—*viâ* Worcester and Hereford—Westbury to Salisbury and Castle Cary to Weymouth. This work will entail the equipment of a further 1758 track miles and some 2000 locomotives.

THERE was a buffer-stop collision at Eastbourne, on the Southern Railway, on May 21st last. It was inquired into by Colonel Trench, who now reports that an exhaustive examination having failed to detect any defect in, or possible cause of failure of, the vacuum brake equipment, the only alternative explanation is faulty handling of the train by the driver. He thinks it is probable that the action of the small ejector, supplemented by the crosshead vacuum pump, which is fitted to the "King Arthur" class of engine, restored the vacuum, and the driver, thinking he might stop too soon, replaced the brake handle to the running position, and released the brakes more rapidly than he realised, with the result that it required a fuller application than he expected to produce immediately the final retardation to a stop. The present report is, however, of greater interest because of its reference to the collapse of the underframe of the trailing end of the second coach—a first brake, built in 1905—under the blow from the Pullman next to it, and another Pullman and three other coaches in the rear. Colonel Trench remarks that attention has been drawn in other accident reports of recent years to the desirability of homogeneous strength and design of underframes and of buffering throughout the trains. The Southern Railway officers are fully alive to the desirability of heavier stock and gave Colonel Trench details as to their policy and construction programme for the last five years, which showed that during that period very considerable progress has been made in the provision of heavy corridor bogie stock of an up-to-date type for main line services. In all the circumstances, he doubts if there is justification for serious criticism in regard to the age and construction of the coaches in use on this occasion.

Notes and Memoranda.

IN connection with the equipment of the Dnieper River hydro-electric plant, which is to have four units of 77,500 kVA, there will be some heavy loads to transport from America. The heaviest is said to be a steel shaft 40in. in diameter by 36ft. long, weighing 136,000 lb., and the largest a bearing bracket 16ft. in diameter.

IT is reported from New York that a lubricant, which is not affected by heat or cold, and which resists the diluting effects of petrol or paraffin is said to have been discovered by an American lubricating engineer. It is asserted that, when added to the petrol or lubricating oil of any internal combustion engine, the liquid forms an impenetrable coating over the metal bearings and protects their life almost indefinitely; but no further particulars are yet to hand.

AN apparatus for the dissociation of ammonia to such a degree as to be suitable for use with atomic hydrogen welding equipment has been produced by the General Electric Company of New York. It is capable of supplying enough gas to operate a ¼in. electrode using 70 ampères, and requires 3·5 kW. The dissociator consists of an electrically and thermally insulated alloy tube filled with an ammonia cracking catalyst and connected to a low-voltage, high-current transformer. Suitable inlet and outlet tubes and openings for temperature indicating and controlling devices are provided. All parts subjected to high temperatures are made of heat-resisting alloys and are welded at all heated joints. Threaded fittings are provided for replacing the catalyst and the thermo-couple. Such screwed joints are placed in unheated parts of the dissociator.

IN commenting on the explosion of an economiser, the Engineer-Surveyor-in-Chief, Board of Trade, says: It is clear in this case that the explosion was due to the condition of the cast iron tubes. The wastage is stated to have been internal and would therefore be difficult to detect by visual examination. It is well known that deterioration occurs with the cast iron tubes of these economisers and several violent explosions have resulted. It is, therefore, surprising that an hydraulic test had not been applied since the economiser was new 19 years ago. It should be the usual routine to apply such a test at regular intervals to apparatus of this kind where visual examination cannot be satisfactorily carried out. Owing to proper steps not having been taken to ascertain whether the economiser was in a safe condition to continue working one fireman lost his life.

A NEW surveying instrument with a standard of accuracy better than sixty-three-millionths of an inch, thus permitting the finest measurements ever attempted in field work, has, says the *Canadian Engineer*, been designed and constructed for the United States Geological Survey by Capt. R. L. Atkinson, Chief of the Division of Field Equipment. The instrument is a precise level for use in determining altitudes above sea level, and its use already has reduced the official altitude of Mt. Whitney, Cal., the highest peak in the continental United States, 4½ft. The extra altitude was due to an accumulated error impossible to avoid with the old instruments. Changes of like magnitude are expected for other mountains. Precise measurements of the altitudes in the Rocky Mountain area are essential for the study of earthquakes. Loss within the next few years of a few inches, which could not be detected by the old instruments, would indicate that Mt. Whitney is "slipping."

ACCORDING to a paper in the *Journal* of the Society of Chemical Industry, by Messrs. P. G. J. Guesterbock and C. N. Nicklin, the addition of very small quantities of lead and copper softens tin, whereas the hardness increases when slightly greater quantities of these impurities are added. For instance, taking the purest brand of tin and adding 0·045 per cent. of lead caused a softening, whilst the addition of 0·2505 per cent. of lead caused a distinct hardening and decreased the ductility. With copper, an addition of 0·0116 per cent. caused a softening of the tin, whilst with an addition of 0·0496 per cent. an alloy was obtained having practically the same hardness as pure tin. Now, in a table of typical tin analyses of various brands of standard tin, the lead content varies from nil to 0·012 per cent., so that actually from 0·045 to 0·033 per cent. might be added with advantage where softness and ductility are required. With copper impurities the brands vary from 0·016 to 0·05 per cent., from which it follows that again there is not sufficient copper in any of the listed brands to soften the tin. Arsenic to the extent of 0·008 per cent. increased the hardness of the pure standard tin from 5·4 to 7·8 by the Brinell test, and altered the appearance of the metal, when broken after bending, from a fine granular surface to a lumpy surface.

ALUMINIUM stearate has, according to some notes by the Mallinckrodt Chemical Works of St. Louis, U.S.A., two uses in the manufacture of paint: (1) To prevent settling of pigment in ready-mixed canned paint, and (2) to produce a flatting effect. As a suspension medium, only 1 or 2 per cent. by weight of the stearate is used, and it may be incorporated by throwing it directly into the paint mill with the other pigments, or by first dissolving in a suitable base and then mixing it with the other ingredients in the paint mill. For flatting paints different methods are employed, but they are all similar to the following procedure:—Dissolve about 25 lb. of aluminium stearate in 100 lb. of naphtha or turpentine substitute. This is easily done by sifting the stearate slowly into the solvent, heating gradually and stirring constantly, until complete solution is effected. A better way, to ensure a perfect solution and prevent any particles from settling to the bottom, is to make a paste with the aluminium stearate with as little naphtha or turpentine as possible, and then add the total quantity of solvent to be used. Apply heat after the full amounts of both ingredients have been mixed together. The resulting product will be a jelly-like substance which should be used as a stock flatting agent. To the regular formula for flat paint, add 5 per cent. by volume of this aluminium stearate jelly. Besides giving a flatting effect, aluminium stearate also imparts to paint a water-resisting property which has proved to be of considerable value.

Miscellanea.

WORK has been started on an aerodrome for Cape Town. It will be 6 miles from the City Hall, and will cost over £50,000.

A BRASS and copper tube mill is to be built as an extension of the plant of the Anaconda American Brass, Ltd., at New Toronto, Ontario.

IT is proposed to have a joint sewerage scheme for the towns of Germiston, Bokesburg and Benoni, in South Africa. The cost is put at £197,000.

THE Vancouver Creosoting Company is extending its plant considerably. The improvements under way will increase the capacity of the plant by 50 per cent.

A PLANT for the production of superphosphates is to be put up at Hamilton, Ontario, by Canadian Industries, Ltd. It already manufactures acids and mixed fertilisers.

IT was recently stated in the South African daily Press that the Selection Trust is spending £15,000,000 on the development of its copper properties in Northern Rhodesia.

A TRACKLESS tram, by Guy Motors, Ltd., of Wolverhampton, has been sent to South Africa, and will be tried out in various towns there. It has seating accommodation for 59 passengers.

THE Government of British Columbia proposes to construct another bridge over the Fraser River, either at Vancouver Ladner or at Barnston Island, 10 miles east of New Westminster.

WORK has been started on the construction of a second unit of nitrogen fixation plant, using coke oven gas, of the Ruhr Chemical Company. It will bring the capacity of the plant up to 55,000 tons a year.

SYNTHETIC camphor is, says the *Chemical Trade Journal*, to be manufactured in Saltillo, Mexico, from turpentine produced locally. A small plant with a capacity of 200 kilos. per day is now under construction.

ACCORDING to Professor Kunnakow, of the Leningrad Academy of Sciences, the water of the Tschokrak Lake, near Jalta, in the Crimea, has a very high content of boric acid, whilst at the bottom of the lake there are large amounts of solid boric acid. In the Professor's opinion, the exploitation of this boric acid is an economic possibility.

THE Irish Free State Government is endeavouring to foster the industry of extracting iodine from kelp and is paying £7 a ton for the weed. About 1500 tons of the kelp has been stored in the new iodine factory at New Docks, Galway, and its conversion into iodine will begin in about a month, by which time the machinery will have been assembled.

THE iron industry of Japan is always threatened by the cheap pig iron from India, which is sold at a price below the cost of the home product. Imports are expected to reach at least 250,000 tons of the Indian pig iron by the end of this year, raising the accumulated stock of pig iron in Japan to some 450,000 tons. It is feared that such a heavy stock cannot be disposed of satisfactorily.

THE paper and cellulose manufacturing company, A/S Saugbrugsforeningen, Halden, has just built a plant for the manufacture of caustic soda by the Krebs system, and with an annual capacity of about 1600 tons. This output will meet a fair proportion of Norway's needs of the alkali, the official statistics for 1928 giving Norwegian importation of caustic soda in that year as 2438 tons.

FOR the purpose of developing domestic industry, plans are being made by the Chinese Ministry of Industry, Commerce, and Labour for the organisation of five large Government factories, namely, a textile factory, woollen mill, a salt and sugar refinery, and a chemical laboratory. It is understood that the capital required will be provided out of a public loan of 15,000,000 dollars, to be exclusively used for the development of industry.

IT is announced that the Bonna Pipe Company of Canada, Ltd., is to proceed with the erection of a new plant in Montreal in the very near future for the manufacture of steel core reinforced concrete pipe by the "Bonna" system. The new company holds a contract for the supply of a large quantity of 36in. pipe to be used on Montreal water main extensions, and as soon as a suitable site can be decided on construction is to start on the new manufacturing plant with the object of having it ready for production about January 1st.

THE "Prométhée," which is one of the first of twenty-five submarines of the same class to be constructed, was launched at Cherbourg last week. She has a length of 90 m. and a beam of 9 m. The displacement at the surface is 1550 tons, and submerged 2000 tons. The armament will consist of twelve torpedo tubes, one 100 mm. gun, one 38 mm., and a machine gun. The vessel, which is fitted with two fuel injection engines of 500 horse-power each and two electric motors each of 600 horse-power, will have a thirty days' cruising capacity.

THE yellow birch (*Betula lutea*) is commercially the most important hardwood in Canada, forming more than one-third of the hardwood lumber produced in that country. For a long time lumbermen looked upon it as a "weed" tree, largely because of the difficulties of transport. It cannot be floated long distances down stream as readily as can the conifers or softwood species with which it is associated in the forest. However, as other timber is becoming more scarce, operators in the woods are beginning to take more interest in yellow birch, and its excellent and outstanding qualities are becoming better known.

THE Montreal Harbour Commission has decided to spend 2,000,000 dollars during the next six months on harbour improvements. The principal item is reconstruction of the downstream side of King Edward Pier at the foot of St. Lawrence Boulevard, to be completed at an estimated cost of 1,500,000 dollars. A new two-storey shed will be constructed on the pier, which will include several grain conveyor galleries, and will give accommodation for two 20,000-ton liners to berth alongside the pier. The McColl-Frontenac wharf will be extended to three times its present length, and the Laurier pier in the eastern part of the main harbour will be reconstructed.

LONDON AND NORTH-EASTERN RAILWAY—SIGNALLING SCHOOL AT YORK

(*For description see page* 488.)

GENERAL VIEW OF THE SCHOOL

THE MODEL RAILWAY

SIGNAL BOX "B" OF MODEL RAILWAY

FULL SIZE POINT LAY-OUT

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The Metallurgist.

THE OCTOBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

VOL. CL No. 3903

OCTOBER 31, 1930.

The Growth of Civil Aviation.

IN his presidential address to the Royal Aeronautical Society, Mr. C. R. Fairey essayed a very difficult task. He sought to demonstrate the growth of aviation, particularly during the past ten years. He set about the work courageously and with his eyes fully open to the snares lying in his path. Basing his arguments on statistics, many of them laboriously compiled, he reached the general conclusion that aviation is growing, and growing very quickly. In detail he demonstrated that the advance in technical achievement was apparently proceeding unchecked, and that the limitations imposed by natural law had as yet scarcely begun to affect progress in this section of his subject. Whilst military aviation was advancing slowly, civil aviation, he declared, was proceeding triumphantly. Unsubsidised flying was developing at a rapid rate and subsidised flying was approaching a true commercial basis. Mr. Fairey's address will certainly provide a stimulus to all connected with aeronautics, but it may be doubted whether everyone outside the industry will find it wholly convincing. In places the data on which Mr. Fairey founded his conclusions are above criticism, and the deductions drawn from them beyond dispute. World's records for duration, altitude and speed yield exact unequivocal figures. Plotted over the years they give impressive curves indicating extraordinary progress. Expenditure on military aviation, in the case at least of four of the leading aeronautical Powers, provides another set of definite figures which reveal, with no great amount of ambiguity, the truth of the deduction which Mr. Fairey draws from them. But when we come to examine the basis of his most interesting conclusion, the triumphant advance assigned to civil aviation, doubt assails us. Unwillingly we ask ourselves if Mr. Fairey has been strictly and judicially unbiassed and impartial in the handling of his material; if sometimes he has not allowed his natural desire to prove that civil aviation is advancing with great strides to get the better of his logical sense of proportion.

On what basis are we to judge the growth of civil aviation? Various criteria suggest themselves. The number of miles flown per year by machines engaged in the transport of passengers, goods, and mails on regular air routes is one. A second is the number of miles flown annually by machines engaged on training, air survey, and other forms of private or non-regular flying. The number of passengers carried per year or the weight of goods and mails is another. Or, again we might study the sum spent on subsidising civil aviation and analyse it on the basis of miles flown per pound of subsidy. In these various ways Mr. Fairey presented the case for civil aviation. Each, he claimed, provided strong support for the deduction that civil aviation is very rapidly progressing. Examination of the data shows, however, that the contributions to the totals made by the United States of America colour and almost swamp the contributions of other countries. Unless, therefore, extreme care is exercised deductions from the statistics which are available will be conclusions concerning the growth of civil aviation in the United States and not of civil aviation in general. That outcome would be of little consequence if we knew with certainty that the condition of American civil aviation was typical of the world's as a whole. Actually, we know with certainty that it is abnormal. The rapid increase in the aircraft industry of the United States represents, as Mr. Fairey himself puts it, not a growth of aviation, but a growth of optimism on the part of the investor. Again, the annual performance figures of American aircraft are very materially affected by the fact that the Government is prepared to spend, and does spend, between three and four million pounds annually on subsidies to the air mail contractors. That the aviation position of the United States is abnormal is supported by the statement made by Mr. J. D. Siddeley last week to the effect that an American aeroplane business of which he is a director lost £700,000 last year, and that another undertaking, the Curtis-Wright Company, lost in the same time £1,100,000, and had 6000 engines in stock for which it could not find a market. It is next to valueless as a sign of growth in civil aviation to point to the fact that the total number of miles flown in 1928 was 60 million and in 1929 190 million, if, as is the case, about 90 per cent. of that increase falls to the credit of the United States. Of the various criteria whereby the growth of civil aviation might apparently be judged the most appealing to many people is probably the figure representing the subsidy paid per mile flown on the regular air routes. Mr. Fairey shows that in 1920 the subsidy paid amounted on the average in all countries to 5s. 4d. per mile of flying. In 1921 it increased to 5s. 9d. Thenceforward it steadily decreased until in 1925 it fell to 3s. 4d., and in 1929 to 1s. 11d. Mr. Fairey considers that these figures provide a very good omen for the future of aviation. The deduction may be sound, but the premises appear to be faulty. It is obvious that if subsidies were paid at any given rate of so many shillings per mile flown, the average subsidy rate for the world would be a measure of the liberality of the governments concerned, and not of the progress of aviation. Actually, the basis on which subsidies are paid is scarcely the same in any two countries. The British basis is a compound one, involving the miles flown and the horse-power of the machines employed. What the subsidy paid per mile flown, when averaged over the world, really represents in these circumstances we are at a loss to say. Mr. Fairey's implication is that a reduction in the average subsidy paid per mile flown is a sign of growth in civil aviation. We are open to be convinced that it, in truth, does provide such a measure. We are also open to be convinced that Mr. Fairey's method of arriving at the average subsidy is actuarially, let alone arithmetically, sound. As we have already indicated, the sum paid annually by the American Government to its air mail contractors reaches a very large figure. In 1929 it amounted to £3,630,000, or almost exactly ten times the sum paid by our own Government in the same year as subsidy to Imperial Airways. It is very doubtful in what light the American Government's expenditure should be regarded as a subsidy comparable with the subsidies paid to civil aviation undertakings by the British, French, Italian, and German Governments. The American expenditure is in the nature of payment for services rendered. The European payments are in the

nature of gifts intended to render profitable certain otherwise unprofitable undertakings. Mr. Fairey gets over the difficulty in an ingenious manner. During 1929 the American Government recovered from the public by way of air mail fees a sum of £3,424,000. The real subsidy which it paid for the support of civil aviation was therefore, according to Mr. Fairey, only £206,000. That is the figure on which he bases the American contribution to the average subsidy per mile flown. We would, however, ask him whether in the use of this figure as a measure of growth in civil aviation we are really concerned with the net disbursements of the governments. In our view the governmental expenditures on civil aviation are of interest and value as measures of such growth only in so far as they indicate in some way the costs of running an aeroplane service or the extent to which these costs exceed the receipts derived from its operation. Mr. Fairey's net figure of £206,000 is quite unrelated to either of these factors.

The practice of civil aviation is undoubtedly increasing in volume, but it is questionable whether at this stage it is either possible or profitable to assess the rate of growth. It would be rash to do or say anything which would encourage the belief that civil aviation is now well on the way to manhood. It cannot with truth be claimed to have reached as yet even the years of adolescence. In 1925 Imperial Airways, in spite of a subsidy of £137,000, made a loss of £15,217. In 1929 it was enabled to return a profit of £78,861 with the assistance of a subsidy of £341,500. During the five years of its existence it has received an aggregate subsidy of £1,106,700 and has earned a net profit of £127,260. Even last year the subsidy received from the Government constituted 50 per cent. of the company's income. The successive annual balance sheets undoubtedly reveal a growing annual profit, but it is far more than explained by the growth in the annual subsidy. It is a fond parent who boasts of the growth of a child which at the end of five years is only kept alive by feeding it to the extent of 50 per cent. on an artificial diet. Growth there undoubtedly is, but we must not lose our sense of proportion when dwelling upon it. A satisfactory corrective to any undue exuberance can be extracted from Mr. Fairey's address. Last year the total of the subsidies paid in connection with the operation of regular civil air services throughout the world was not far short of £5,000,000. The number of passengers carried by these subsidised services totalled 500,000, the weight of goods 9000 tons, and the quantity of mails 5000 tons. It is quite impossible to say in what proportion the subsidy should be divided between the passengers and the freight. But if we divide it half and half we have the result that the carriage of every passenger on a regular air service is subsidised on the average to the extent of £5 and every ton of goods and mails to the extent of about £180. These figures may be left to speak for themselves. If civil aviation is proceeding triumphantly, as Mr. Fairey claims, it must be triumphing in the unsubsidised, private or non-regular branch. There is little indication of any triumph or approaching triumph in the subsidised section.

Railway Accidents.

Two years ago, after twenty-five passengers had been killed in the railway disaster of June 27th at Darlington, a terrible calamity occurred at Charfield on October 13th, and, twelve days later, on the same railway system, one at Dinwoodie. Then, when the new year had hardly opened, there happened, on January 8th, the accident at Ashchurch, which, though less serious in personal injuries, caused the most complete wreck of a passenger train for many years. As a consequence of these events, there was a great outcry in the Press and in Parliament, and the reputed safety of British railways was challenged. So serious was the situation that we had considerable difficulty in proving—possibly even to convince ourselves—that the occurrences of these accidents within a short period was due only to a coincidence and gave no grounds for pessimism. We congratulate the travelling public and the officers and servants of British railways—incidentally, taking a little credit to ourselves—that our attitude has proved to be correct. The annual report by Colonel Mount, the Chief Inspecting Officer of Railways, for the year 1929, shows that the Ashchurch accident mentioned above was the only one during that year in which passengers lost their lives. To that remarkable result may be added the further gratifying fact that no further fatal accident occurred until March 6th last, when one passenger was killed at Culgaith. Remembering what was happening two years ago, we dare not make any forecast, but must content ourselves by observing that if this commendable immunity be continued to us for just over another two months, the record in this respect for British railways will be only one passenger killed in a train accident during a period of two years. British railways have not always enjoyed this immunity; it is only within the present generation that they have reached such perfection. Reference to Mr. Raynar Wilson's "Railway Accidents: Legislation and Statistics, 1825–1924," shows that fifty years ago—during the five years 1876–1880—there were 38 cases of bursting of boilers or tubes of engines; 47 failures of machinery, springs, &c., of engines 5297 failures of tires—failures of wheels got so rare as to be omitted later—and 2495 failures of axles. The Railway Accident Returns for 1929 give the corresponding figures for the five years 1925–1929, as 11, 116, 251 and 345. From the same sources we learn that in the 1876–1880 period there were 742 collisions in which passenger trains were involved, and ten years later there were 444 such accidents. That reduction of practically 40 per cent. was due, mainly, to two things—the extension of the block system, together with the concentration of points and signals, and to the adoption of continuous brakes. We may recall that The Engineer was, in those earlier days, very emphatic as to the need for continuous brakes. In our issue of January 28th, 1876, we observed, after the Abbott's Ripton collision of the 21st of that month: "Is it necessary to add another syllable to show that a fairly good continuous brake would have deprived the Abbott's Ripton accident of nearly all its horrors and would have spared the pockets of the company many thousands of pounds." After the Arlesley collision of the following December 23rd, we remarked in our issue of December 28th: "It has now been proved by four great accidents—that at Abbott's Ripton, that at Thorpe, that at Radstock and now this at Arlesley—that the block system must, to be efficient, be supplemented by some satisfactory method of stopping a train . . . In the same way as at Abbott's Ripton, lives would have been saved and thousands of pounds of property preserved to the company if the down express had been fitted with a continuous brake." The four accidents thus named were: Norwich, Thorpe, September 10th, 1874, 21 passengers killed; Abbott's Ripton, January 31st, 1876, 14 killed; Radstock, August 7th, 1876, 12 killed; Arlesley, December 23rd, 1876, 4 killed. To these there might have been added Kildwick, August 28th, 1875, 7 killed.

When we turn to the number of collisions in which passenger trains were involved, we find that as compared with the above-named 742 and 444 for the five-year periods fifty and forty years ago respectively, the present figure is 411. That figure does not differ much from that of 1886–1890, but it must be remembered that the train mileage has increased by 25 per cent. and the train miles per route-mile of railway, *i.e.*, the traffic density, by 50 per cent. We desire, however, to consider the collisions of the present day in a different relation from that devoted to the general question in our earlier remarks above. At the end of the year 1906 many accidents to goods trains and failures of equipment were reported for the first time as a consequence of an Order of the Board of Trade. The result is that the conditions appear to have deteriorated. In 1925–29 304 collisions between passenger trains and goods trains, light engines, &c., were reported, when, apparently, there were only 258 such accidents forty years ago and exactly the same number—258—thirty years ago. It is necessary, in this connection, to bear the influence of the change in the Returns in mind. The real fact is that there is a great decrease in the number of collisions between passenger trains. They totalled, for the last quinquennium, 107, as compared with 184, 233, 217 and 172 respectively for the four five-year periods so recent as between 1901 and 1920. Now, most collisions between passenger trains occur in stations, and such a decrease as that noted suggests that greater care is exercised in these localities. It is, however, known that the quality of our signalmen and drivers has not improved—in fact, their record is such that no improvement in the watchfulness their work calls for could be expected. Nor has there been any improved method in block working or in outdoor signalling as generally understood. Track circuit has, however, been added to the operation of the outdoor signals and, in part, to the block system. Therein lies, we are satisfied, the reason for the reduction in the number of collisions between passenger trains. For these better results we are, in the main, indebted, just as was the case forty and fifty years ago, to the publicity given by the accident reports of the Inspecting Officers—then of the Board of Trade, but now of the Ministry of Transport. The attention of British railway officers was drawn to the benefits of track circuit by installations, thirty years ago, on the London and South-Western, Lancashire and Yorkshire, North-Eastern, and on the Metropolitan District Railways. But all sorts of bogeys—long since killed—were raised and little was done until the Hawes Junction accident of December 24th, 1910, when a couple of light engines standing on the main line were overlooked. When the collision of September 2nd, 1913, at Ais Gill occurred on the Midland Railway, Sir Guy Granet told Sir John Pringle that an investigation carried out after the former collision revealed 2000 places at which it would be desirable to install apparatus for correcting that tendency towards human error. It is very evident, from the figures we give above, that all the companies have done much in the instalment of track circuit since then, but that much remains to be done may be judged from the fact that its adoption was recommended in three of the fifteen reports on collisions that were inquired into last year and which are covered by Colonel Mount's present report. It only remains to be said, in respect of that document, that the satisfactory results, as regards safety, of the year's working are reflected in his report. The benefit of public attention being drawn by the accident reports to methods of operation that appear questionable is indicated by Colonel Mount's comments on the Ashchurch accident mentioned above. In The Engineer of April 19th, 1929, we drew attention to some weaknesses in operation during foggy weather which the Ashchurch collision revealed. It is a satisfaction, then, to note that Colonel Mount's present annual report says that "this accident brought prominently to notice the necessity for more restrictive methods of block working in fog, which were subsequently adopted; as also the need for revision—which has since been made—of the arrangements for calling out and posting fogmen, who were not present on that occasion."

The accident at Ashchurch is the only one of which it is specifically stated that automatic train control would have been of assistance. On that point we, naturally, must say something of the action of the Great Western Company in increasing the 372 track miles already equipped with its own system of automatic train control by a further 1758 track miles and adding some 2000 locomotives to the 334 equipped with the necessary apparatus. Such a decision appears strange in view of the fact that the Automatic Train Control Committee has not yet reported, and stranger still as the Committee's report is expected by about the end of the year. Mr. C. B. Collett, the chief mechanical engineer of the Great Western, is a member of the Committee, and one wonders whether what his company is doing is in defiance or in anticipation of what the Committee will recommend. We have always thought that the case for automatic train control had not been made out; cab signals, which are a simpler matter, were, in our opinion, sufficient. But if more than the latter were required we were, as related in our leading article of April 19th, 1929, in favour of a simple control like that on the Great Western. One thing we now fear is that an impression may get abroad that the Great Western Company's action is the result, or the fear, of accidents. That, we suggest, is not the case. Its action is probably due to two very interesting economic reasons. One is that, when provided with a cab signal, a driver can, in fog, maintain his speed and thus avoid delays. The other is that fog signalmen can then be dispensed with and that saves an item which costs the companies £100,000 a year. Thus automatic train control would be used to effect economies in train running and fog signalling and not primarily in order to avoid accidents.

Literature.

Flood Flows: A Study of Frequencies and Magnitudes. By Allen Hazen, Sc.D., M. Am. Soc. C.E. London: Chapman and Hall, Ltd. 1930. Price 20s.

A serious treatise on floods must be largely based upon data and studies extending over long periods, and Mr. Hazen is exceptionally well equipped in that respect as a result of systematic work carried on for more than twenty years in his office. The methods of dealing with data, as practised in 1914 and described

by Mr. W. E. Fuller—"Transactions," Am. Soc. C.E., Vol. 77—have since been expanded and perfected in such a manner that the information can be presented by tabular and graphical methods which greatly shorten the work and ensure uniformity. It is, however, the practice of the author and his co-workers to bring to bear in every case demanding it the judgment necessary to the sound interpretation of the results, while, in the book, the nature and basis of every procedure and curve are explained in terms which leave the reader without excuse should he misapply the figures. The chapters on methods of plotting, coefficients of flood, of variation and of skew, the effects of one large flood, the flood ratio factors, the duration curve method, and the extreme flood method, all relate to the systematic arrangement of data, so as to give information precise in relativity and important as absolute on a predetermined basis. Further, those chapters contain very useful discussions of important points in engineering practice.

The author takes the view that " . . . liberal allowances must be made to cover extreme conditions that may possibly happen some time, but that are unlikely ever to happen in any given case." Also, in respect of curves representing flood flows of different degrees of rarity, he prefers, when there are alternatives, the form which gives the higher estimate for extreme values. This suggests that there may be advantages in employing the typically British method of estimating the maximum flood which need be considered by means of a simple formula and varying the numerical coefficient by judgment based on comparative data and the nature and position of the catchment. It must be admitted, however, that the upper limit of the coefficient may be considered in the light of studies of periodicity such as are supplied by Mr. Hazen. In this connection it may be remarked that for catchments between 500 and 6000 square miles, Mr. Hazen uses an index 0·8 for twenty-four-hour floods, exceeding that of Dickens for peak floods, that is, modifying the area less, while for peak floods he takes 0·7, or only a little more than the Ryves index of $\frac{2}{3}$.

In the chapters on obstructions, *débris* and sediment, and in those on storage, channel control and methods of flood protection, the author deals very briefly with some main points of those subjects, but gives good practical advice. More important, if it can be hoped that his advice will be followed, are his observations as to the policy which should be adopted in regard to low-lying areas liable to be flooded. After a disaster foolish persons re-establish themselves in the old positions, where the same thing will happen again sooner or later, and money is spent in the track of a future flood. (The author calls it the "inevitable" track, but he is pointing out that it should be avoided.)

Mr. Hazen's data are solely those of the United States, in which the range of conditions is great enough to make his book of general interest. The limitations are, in some respects, important, but hardly affect the value of his presentment of methods of dealing with data and the main criteria for final judgment of their significance. That presentment is admirable in form and substance, and no engineer who is concerned with floods should fail to study it with care.

Geodesy. By GEORGE L. HOSMER. London: Chapman and Hall, Ltd. Second edition. 1930. Price 22s. 6d.

IN view of the developments of the past ten years, Professor Hosmer has prepared this revised edition of his useful text-book and has enlarged it to some 450 pages. He now includes Clarke's solution of the problem of computing geodetic positions—Ordnance Survey of Great Britain, 1858, and Clarke's "Geodesy"—pointing out that it is to be preferred to the Puissant formula when greater accuracy is required.

Another important change has resulted from the applicability of wireless time signals to the determination of latitude, the method being described with diagrams of electrical connections in both the transit micrometer method and the key method. Other changes as to which information is given include new standards of accuracy for base lines, and new designs for theodolites, vertical collimators, signal lamps, observing towers and levelling staves. A strip of invar is attached to the face of the levelling staff now used by the United States Coast and Geodetic Survey, the centimetre divisions being painted on the strip.

As indicated by the sub-title, the author deals with the subjects: astronomical observations, gravity measurements, and the method of least squares. The chapters on astronomy and on least squares are, it is explained in the preface to the first edition, included for the sake of completeness and are not more than introductions to standard works. It may, however, be pointed out that Chapter IV., Astronomical Observations, occupies nearly sixty pages, comparing favourably with more or less corresponding chapters in some books on surveying.

The work is very well printed, an important matter when many formulæ and tables have to be included, and it has 159 illustrations. Besides serving well its primary purpose, it may be recommended as a book of reference for engineers and for surveyors employed in civil engineering surveys. It supplies, in some cases, fuller information than is to be found in books which they ordinarily use, and it may serve also to make evident their limitations in regard to some of the more difficult computations and corrections of observations.

Engineering Economics. By T. H. BURNHAM, B.Sc., B.Com., A.M. I. Mech. E. London: Sir Isaac Pitman and Sons, Ltd. 1930. Price 10s. 6d. net.

THAT this is a subject which has an increasing appeal to the present-day engineer is evidenced by the fact that a second edition of a book devoted to its consideration is warranted a year after it was initially published. Although its general character has not been altered, additions to most of the chapters have been made, with the result that an increase of about fifty pages has proved necessary.

The field covered is so wide that perhaps it would be ungenerous to affirm that the specialist will not find much to interest him in the section devoted to his particular branch; but when an attempt is made to deal with money and credit, banking and foreign exchange, taxation and insurance, trade unionism and employers' associations, as well as joint stock companies, legislation and research, to say nothing of the various functions more usually associated with factory organisation and management, in a relatively small volume, it is obvious that no branch can be treated exhaustively. Nevertheless, there will be few, if any, engineers who would not find a good deal to interest them in "Engineering Economics," as it is essentially readable and well considered.

It is primarily intended for the student, who, having passed through his theoretical training and apprenticeship, is desirous to qualify for membership of one of the engineering institutions, and for such this treatise will be most helpful. For example, it admirably covers the syllabus of the "Economics of Engineering" in the examination of the Institution of Mechanical Engineers.

The diagram on page 181 is a particularly happy one, showing as it does the three main types of industrial organisation clearly set out on the one sheet, rendering comparison an easy matter, while the main principles are readily grasped and committed to memory. We should like to see an extension of this method of graphical representation in future editions.

The Spirit of Chemistry. By ALEXANDER FINDLAY. London: Longmans, Green and Co. 1930. 10s. 6d. net.

MODERN engineers are called upon to be, if not exactly proficient, at least familiar with the current development in a great many branches of science. Physics, chemistry, and even biology are subjects intimately connected with engineering practice, and progressive activity in each of these directions has long ceased to be the sole concern of a small circle of specialists. That the professor of a particular branch of science may retain a live interest in the sister sciences demands a particular type of literature. It cannot be said to be "popular" in the sense of books written for the delectation of the dilettante, but, at the same time, highly specialised technicalities are obviously out of place. Professor Findlay's work on chemistry is a good example of such writing. He has produced a comprehensive work which, although it is by no means suitable as a text-book for a student of chemistry, yet is technical enough to endow the students of other sciences with a very real working knowledge of the whole subject. This was Professor Findlay's aim in writing the book, and he has achieved success.

There are valuable and interesting historical sketches concerning important laws and processes, illustrated by interesting portraits and contemporary pictures. The author deals with general physical and chemical phenomena in a broad and readable fashion, and traces their development up to the present time. Not the least valuable aspect of this book is that the various scientific activities are shown with a due regard to a general perspective.

There are several details, particularly in the part relating to physics, that might have been expressed more accurately, but in no such case does the passage detract from the general value of the book. The two chapters dealing specifically with metallurgical subjects are interesting, and it is a pity that these subjects were not developed in a little more detail by such an attractive writer as the author; but in view of the very wide field so well covered in a small volume such a criticism is perhaps unfair.

The book is well produced and copiously illustrated, and may be recommended with confidence as an interesting and valuable contribution to modern, non-specialised scientific literature.

SHORT NOTICES.

Piping Handbook. By J. H. Walker and Sabin Crocker, with contributions by others. First edition. London: McGraw-Hill Publishing Company, Ltd. 1930. Price 25s.—The stoutness of this very specialised volume brings home to us the present-day importance of piping for all sorts of purposes. The authors are two American engineers, connected with the Detroit Edison Company, Mr. Walker being the superintendent of central heating. In the United States piping problems unknown in this country have to be faced—such problems as the transmission of hot water and steam in city central heating systems, and the conveyance of gas and oil over great distances. It is, therefore, not surprising that a handbook has been found necessary there. The volume contains, as far as we can see by inspection, but little padding, and what there is may be regarded as really cognate to the subject. A great deal of the material has been drawn from periodical, transaction and similar sources, but certain specialised subjects, including Heat Insulation, Water-supply Piping, Oil Piping, Gas Piping, have, we are told, been handled by recognised authorities, each in his own field, and attention is directed by the authors to chapters on Expansion and Flexibility, Steam Power-plant Piping and Oil Piping. It is, of course, quite out of the question to check the accuracy of the many tables which occur in a compilation of this kind, but we venture to suggest that on revision all the longways charts should be made to read the same way up; they are sometimes right-handed, as on pages 224 and 225, which we think most readers find inconvenient—the top heading should always be on the left. That, however, is a very small blemish upon a book which is likely to prove useful to engineers in many branches.

Electric Testing Simplified. By H. H. U. Cross. London: Crosby Lockwood and Son. Price 5s.—The class of electrical testing with which this book deals is that which concerns the electrical contractor and others associated with electrical work. The book will not appeal to any appreciable extent to those who desire to acquire information concerning efficiency and other tests on large electrical plant, but as a handbook on single testing as carried out on electricity consumers' premises, &c., it is quite useful. After dealing with fundamental units and definitions, Ohm's law, parallel and series circuits, and various other matters with which all electrical testers should be familiar, the author deals with measuring instruments. A large part of the book is devoted to descriptions of various kinds of instruments used for testing purposes. Considerable attention is paid to insulation testing and the measurement of resistance by means of the Wheatstone bridge. A chapter on domestic electric appliances deals with various matters which scarcely come under the heading of testing, such, for example, as the cost of heating water and the repair of electric heating elements. Other sections of the book deal with the testing of cells, motors, generators, and motor car electrical plant.

BOOKS RECEIVED.

Gusseisen Eigenschaften und Prüfverfahren. Berlin: VDI-Verlag G.m.b.H., N.W. 7. Price 6 marks net.

City of Sheffield, City Engineer and Surveyor's Department, Report of the Highway and Sewerage Committee for the Year ended March 31st, 1930.

A Handbook of English in Engineering Usage. By A. C. Howell. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 12s. 6d. net.

Engineering Science: A Second Year's Course. By W. Ward, B.Sc. London: Edward Arnold and Co., 41, Maddox-street, W. 1. Price 5s. net.

Experimental Mechanics of Materials. By H. Carrington. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 3s. 6d. net.

Annales des Ponts et Chaussées, 1930. Tome I. Fasc. 3, Mai-Juin, (1) Partie Administrative, (2) Partie Technique. Paris: A. Dumas, 5 Rue Jules-Lefebre.

Metallurgy of White Metal Scrap and Residues. By E. R. Thews. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

Valves and Reversing Gears. By Beatson Hutchinson. London: The Draughtsman Publishing Company, Ltd., 96, St. George's-square, S.W. 1. Price 2s. net.

Limestones: Their Origins, Distribution and Uses. By F. J. North, D.Sc., F.G.S. London: Thomas Murby and Co., 1, Fleet-lane, E.C. 4. Price 16s. net.

The Evolution of Industrial Organisation. Second edition. By B. F. Shields. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 10s. 6d. net.

Principles of Electric Power Transmission by Alternating Currents. Second edition. By H. Waddicor. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 21s. net.

Impurities in Metals: Their Influence on Structure and Properties. Second edition. By Colin J. Smithells. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 18s. net.

A Practical Treatise on Single and Multi-stage Centrifugal Pumps. By R. Defeld, translated by C. W. Olliver, B.A., &c. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 21s. net.

Engineering. By A. Purves Gest. (*Our Debt to Greece and Rome.* Edited by G. Depue Hadzeits and D. Moore Robinson.) London: George G. Harrap and Co., Ltd., 39, Parker-street, W.C. 2. Price 5s.

X-ray Technology: The Production, Measurement and Applications of X-rays. By H. M. Terrill, Ph.D., and C. T. Ulrey Ph.D. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 21s. net.

Mineral Resources of the United States, 1927. *Part I., Metals; Part II., Non-metals.* By F. J. Katz. Washington, D.C.: The Superintendent of Documents. Price: Part I., 1·25 dollars; Part II., 1·00 dollar.

Five Years of Research in Industry, 1926–1930: *A Reading List of Selected Articles from the Technical Press.* Compiled by C. J. West. New York: National Research Council, 29, West 39th Street. Price 50 cents net.

The Theory and Design of Illuminating Engineering Equipment. By L. B. W. Jolley, M.A., M.I.E.E., J. M. Waldram, B.Sc., and G. H. Wilson, B.Sc., A.M. Inst. E.E. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 45s. net.

Applied Mathematics for Engineers. Volume 1, *Graphical Statics; Volume* 2, *Dynamics, with an Introduction to the Differential and Integral Calculus.* By T. Hodgson, B.A., B.Sc. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price: Volume 1, 9s. 6d. net; Volume 2, 13s. 6d. net.

L.N.E.R. Signalling School at York.

A RAILWAY signalling school which has recently been installed by the London and North-Eastern Railway at York was opened on Thursday, October 16th, the members of the class being welcomed by Mr. William Whitelaw, chairman of the company, accompanied by Viscount Grey of Falloden and Mr. Clarence Smith, directors. Mr. Whitelaw addressed the class and wished them every success in their studies, and expressed the hope that great benefit would result from the classes. After a brief introduction by Mr. John Miller, M. Inst. C.E., engineer of the company's North-Eastern Area, the first lecture was then delivered by Mr. A. E. Tattersall, M.I.E.E., Signal and Telegraph Engineer, North-Eastern Area, the subject being "The Necessity for and Functions of a Signalling System." The class numbers about sixty men, including mechanical signal fitters, electrical signal fitters and telegraph linemen.

The provision of such a school was necessitated by the rapidly extending use of electrical signalling methods, which has brought with it an ever-increasing difficulty in finding men with the necessary knowledge and experience to maintain new electrical installations as they are brought into use. The signal fitters previously in charge of mechanical signalling installations have rarely sufficient technical knowledge to continue to take charge when new electrical installations are substituted for the mechanical. It is with the object of providing this technical knowledge and of giving the necessary practical training that the school has been provided. The school will also be used for giving instruction to the operating staff in block working and traffic operation.

The two objects of the school are therefore :—

1. (*Technical*).—To give to the staff dealing with the construction and maintenance of signal, telegraph and telephone installations instruction in the principles of electrical and mechanical signalling and of telegraphy and telephony ; and

2. (*Operating*).—To enable the students attending the lectures on block rules and regulations to become conversant with the operating side of signalling.

With the above objects in view the school has been equipped with :—

(A) A model railway layout, and

(B) Exhibits of the various apparatus used in signalling and telegraph installations.

The equipment is described below :—

(A) Model Railway Layout.

The attached diagram illustrates the model railway, and several views of it are given herewith and on page 484. It is of 1¼in. gauge, mounted on a table 50ft. long by 3ft. wide, and comprises a typical double-line junction, together with a single-line junction. Five signal-boxes are concerned, A, B, C, D, and E. At signal-box B all outside connections and signals are worked from a 25-lever N.E. Area standard locking frame, quarter of full size.

The frame is provided with the usual mechanical locking. The rails have been track circuited, there being fifteen track circuits in all, each having different functions to perform. It should be mentioned in this connection that the track layout presents a rather unsual appearance, but the object has been to arrange the model to explain every possible use that can be made of track circuiting. Stop signals are controlled by the track circuit over which they read and for that purpose the controlling levers have been fitted with electric locks. Points are furnished with facing point locks where necessary, and the usual detecting arrangement, as well as the point levers, are also controlled electrically by the track circuits relative to them. The signal and track circuits are interlocked with the block working, the signals being proved at danger before a following train can be accepted, and every safeguard is provided for traffic operation short of apparatus for stopping trains in case signals are passed at danger.

As regards the single-line junction, there is apparatus to enable the single line to be controlled :—

(*a*) By the intermittent track circuit instead of the usual token instruments, as obtains in several cases at present on the N.E. Area ;

(*b*) By electric tablet in combination with the occupation key system ; and

(*c*) By the key token system.

An illuminated signal-box diagram is installed for signal-box B. It indicates to the signalman, by means of spot lights, whether or not the tracks under his jurisdiction are occupied. Normally—when a track is unoccupied—the light for that particular track is illuminated. If the track is occupied the light is extinguished.

At each signal-box the necessary equipment of block instruments and bells is provided as follows :—

At A, one single-stroke bell, pinner and non-pinner absolute block instruments for working to B or C ;

At B, one single-stroke bell and combined absolute block instrument for working to A, and a similar set for working to C ; one single-stroke bell and Tyer's permissive block instruments for working to D ; one single-stroke bell for describing trains to E on the single line when working under the intermittent track circuit arrangements ;

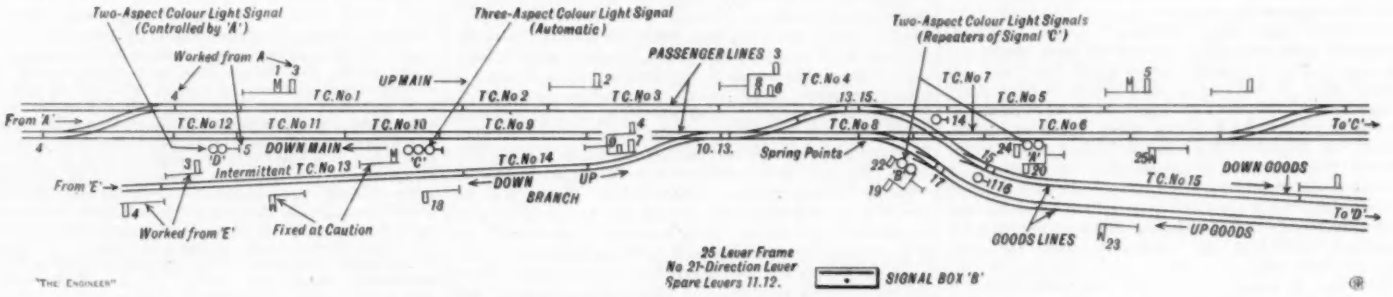
At C, one single-stroke bell, pinner and non-pinner absolute block instrument for working to B or A ;

At D, one single-stroke bell and Tyer's permissive block instruments for working to B ; and

At E, one single-stroke bell for describing trains to B on the single line under intermittent track circuit working.

There is a switch at signal-box B, by means of which, when the block post is switched out, the instruments at A and C are put into communication one with the other. The three altrenative methods of working the single-line branch are set out above. It will be noticed from the diagram that the passenger lines are worked by the absolute block system and the goods lines by the permissive block system.

The principles of automatic colour light signalling are also dealt with, as will be evident from a perusal of the diagram.



LAY-OUT OF MODEL RAILWAY AT YORK SIGNALLING SCHOOL

(B) Exhibits of Apparatus.

Some of the exhibits have been taken from the stock, but in many cases some of the recognised signalling and electrical contractors have lent working models for the purpose of the school. The exhibits are as follows :—

(*a*) *Signalling Exhibits.*

1. Typical full-size point location with relative direction signals consisting of :

(*a*) Battery-worked point layout.
(*b*) Battery-worked semaphore signals with lower mechanical distant.
(*c*) Searchlight-type colour light signal.
(*d*) Five-lever mechanical frame.
(*e*) Two-lever mechanical frame.
(*f*) Three-lever all-electric power frame.

These exhibits illustrate the method employed in controlling positions at distances greater than 350 yards from a signal-box, thus enabling signal-boxes to be dispensed with.

The point layout is track circuited and the battery worked semaphore signal reads through one position of the points and the searchlight colour signal through the other position. It is so arranged that the points and signals may be worked either by the five-lever mechanical frame or by the three-lever all-electric power frame. A relay cabinet, which contains all the controlling apparatus, showing the standard method of wiring in the N.E. Area, is provided, and the mechanical and power frames are fitted up exactly in a similar manner to those in actual use. There is a crank handle for the purpose of working the points in case of failure.

The searchlight colour signal is of interest, as that type of light signal possesses only one lens, the required colour being given by a movable roundel inside the signal. The two-lever mechanical ground frame is used to illustrate the usual method of a ground frame electrically controlled from a signal-box. The three-lever all-electric power frame is also of interest, inasmuch as the whole of the interlocking is done electrically, no mechanical locking being provided whatever.

Two three-aspect—separate indications—colour light signals, each containing three separate light units, one only being illuminated at once, have been installed. In each case the lenses are specially designed to give a satisfactory close-up indication for drivers, whilst in one type sidelights are provided as is found necessary on electric railways. The Adlake Lebby electric signal lamp illustrates what may be termed a mechanical colour light signal. It enables a very small wattage lamp to give a highly concentrated beam, owing to the type of reflector used. The exhibit embodies a lamp fitted behind the mechanical spectacle which can be mechanically worked, thus permitting all the advantages of colour light signalling to be obtained in ordinary mechanical working. The light beam is sufficiently penetrative in the most dense fog to permit of fog signalmen being dispensed with. The lights can be fed from ordinary batteries.

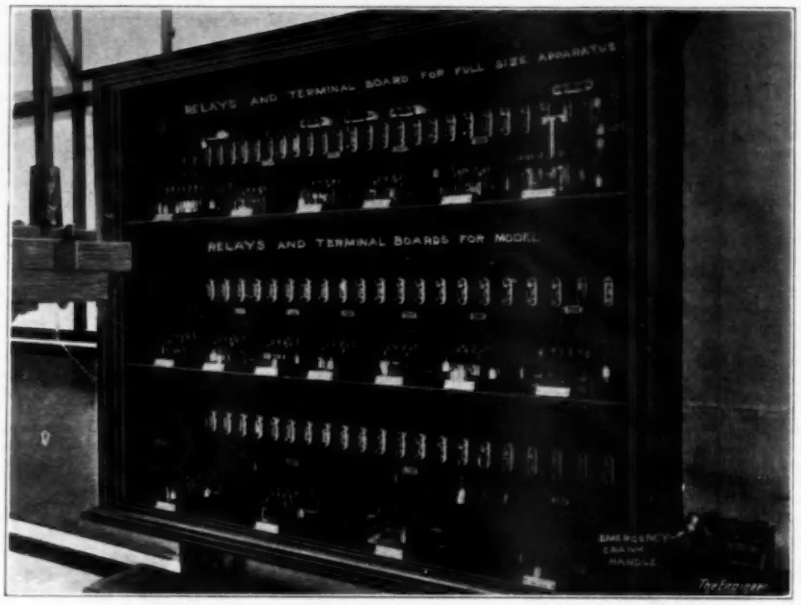
On electrified railways, where both rails are used for the propulsion return, in order to enable insulated joints to be fitted to mark a signalling section, means must be provided to permit the propulsion return bridging the insulated joints without impairing efficiency of the track circuit. Another exhibit illustrates the latest type of apparatus auto-impedance bonds used for that purpose. Its action is to check the flow of alternating current through the bond but to permit the propulsion return to flow from rail

VIEW IN THE SCHOOL

to rail through the bond without affecting the alternating-current signalling current.

The possibilities of the photo-electric cell are many and varied. It is a light-responsive apparatus, and through suitable apparatus can be made to detect minute changes in light. It forms the basis of the talking film and also television. The cell exhibited is connected so that the admission of light to the cell operates an indicator.

An alternating-current track circuit, including feed transformer and double element relays, is also included. For it the necessary alternating-current power being obtained from a small ½ kVA alternator, driven from the 230-volt lighting circuit, the alternating-current



RELAYS AND TERMINAL BOARDS

potential being 100 volts, 50 frequency. For electrified railways, as in the Newcastle Area, alternating-current track circuits must be used, as direct-current track circuits are liable to be interfered with by the traction system. An artificial track circuit is used for reproducing any given track conditions of ballast and rail resistance. It is, therefore, possible to set up in the Signalling School any conditions that may be met with in actual practice, and the performance of the track apparatus can thus be noted under varying conditions.

A relay testing cabinet, which is also on view, has for its purpose the testing of pick-up and drop-away values of relays and demagnetising saturated relay coils. It is also of use for ascertaining the resistance of the contacts. It is very important that relays should be tested in this manner at least every two years, as, if the characteristics should vary in actual practice, safety may be jeopardised.

Among miscellaneous exhibits are the following :—

(*a*) High-voltage alternating-current point machines.
(*b*) Solenoid ground signal.
(*c*) Low-pressure E.P. point motor.
(*d*) High-voltage signal machine.
(*e*) Signal replacer.
(*f*) Low-pressure E.P. point valve.
(*g*) Mechanical escapement for economically worked points.
(*h*) Telegraph pole, showing wire transposition and various methods of securing wires to insulators and jointing.

The telegraph and telephone exhibits comprise :

(1) A 10,000-line automatic telephone exchange, which illustrates the arrangement of the Strowger step-by-step system, which is the standard system of the British G.P.O.

(2) Of traffic-control systems there are two models illustrating different types of traffic control systems :

(*a*) The Standard Telephone and Cable Company's key and selector system, which has hitherto been used on the L.N.E.R.; and (*b*) the G.E.C. dial system, which is being installed at Darlington and is considered to be an improvement on existing systems.

(3) A telegraph repeater exhibit comprises two single-needle instruments equipped with an intermediate relay or repeater. By its use the strength of signals over long or bad lines can be increased, and it enables the number of batteries on existing circuits to be considerably decreased.

(4) Block instruments, key token instruments, bells, &c., are provided in connection with the model railway lay-out described above.

(5) A public address system, which comprises a microphone, amplifier and two loud speakers, illustrates the method by which ordinary speech may be magnified and amplified as necessary.

The necessary power for working the various models is obtained from the 230-volt lighting supply, which is used to charge the accumulators for giving the various voltages.

A syllabus has been prepared for both technical and operating sections, and classes will be held weekly in each section during the coming winter. The instructors will be drawn from the members of the headquarters staff, and an examination on the course of instruction given will be held at the end of the session.

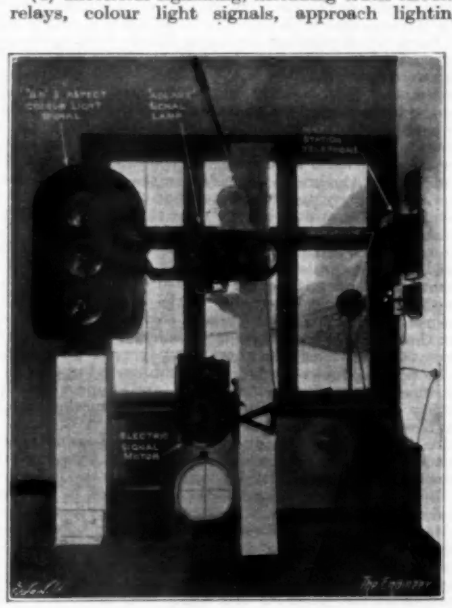
The syllabus for the technical section embraces the following :—

(1) General principles of signalling systems, including Ministry of Transport requirements, types of signals, signal-box arrangements, interlocking, regulations for working trains for single and double lines, &c.

(2) Mechanical signalling, including signalling of various lay-outs, principles of interlocking ground, frames, slots, compensation, mechanics as applied to signalling, &c.

(3) Fundamental principles of magnetism and electricity, including conductors and insulators, Ohm's law, primary and secondary cells, resistance coils, ammeters, voltmeters, battery tests, alternators, &c.

(4) Electrical signalling, including track circuits, relays, colour light signals, approach lighting,



COLOUR-LIGHT AND SEMAPHORE SIGNALS

point and signal motors, principles of amalgamation schemes, &c.

(5) Telegraphy, including single needle instruments, sounders, relays, duplex working, block instruments, tablet and key token instruments, train staff, &c.

(6) Telephony, including wiring, battery type telephones, micro-telephones, block-bell telephones, phonopores, buzzers, switchboards, automatic signalling, &c.

(7) Special lectures on printing telegraphs, automatic telephones, telephone repeaters, traffic control systems, alternating-current track circuits, &c.

The operating course consists of no less than twenty lectures, and the syllabus includes the following subjects :—

(1) Regulations for block working :—
(*a*) Double lines.
(*b*) Train staff and ticket.
(*c*) Electric tablet, staff, and key token.
(*d*) Working under recording regulations.
(*e*) Description of instruments, switches, &c.

(2) General rules and instructions, including :—
(*a*) Use of fixed, hand and detonating signals.
(*b*) Detention at home or starting signals.
(*c*) Working during foggy weather or falling snow and equipment and machines in connection therewith.
(*d*) Working of points and signals.
(*e*) Station yard working.
(*f*) Working of level crossings.
(*g*) Working of trains.
(*h*) Trains stopped by accident, failure, &c.
(*i*) Working traffic of a double line over a single line.
(*j*) Permanent way and works.
(*k*) Regulations for working on non-block lines.
(*l*) Out-of-gauge loads.
&c.

The school has a seating capacity of about sixty, and both the technical and operating classes have had to be limited to that figure. Several times that number of applications for permission to attend the classes have, however, been received from the staff, and it is possible the classes may be duplicated.

The track lay-out and signalling of the model railway were approved by Mr. C. M. Jenkin Jones, Superintendent, and Mr. John Miller, Engineer, N.E. Area, L.N.E.R., while the actual construction and equipment of the school were carried out to the design and under the supervision of Mr. A. E. Tattersall, Signal and Telegraph Engineer.

The Institute of Fuel.

No. I.

THE annual two-days' Conference of the Institute of Fuel was held in the Hall of the Society of Incorporated Accountants and Auditors, Victoria Embankment, London, on Wednesday and Thursday, October 22nd and 23rd, and, as usual, there was a varied programme of papers and discussions. The President, Sir David Milne Watson, delivered his Presidential Address on Wednesday morning, and in the afternoon two papers were read, one dealing with industrial applications of fuel oil, and the other with the use of coke breeze. The feature of the meeting, however, was a symposium on Thursday, October 23rd, on fuel problems in the mercantile marine, the whole day being devoted to it.

Sir David Milne Watson, in the course of his Presidential Address, first drew attention to the Institute's continued expansion, the membership having increased 35 per cent. in the past year. Two provincial sections had been established, with meeting places at Manchester, Nottingham, Derby and Bristol.

Sir David announced also that Lord Melchett—the Institute's Founder-President—had endowed a medal, to be known as the Melchett Medal, for the recognition of original work in connection with the use of fuel. The first recipient of the medal would be Dr. Kurt Rummel, Director of the Warmestelle, of Düsseldorf, who had been engaged on fuel economony research and co-ordination work in the German iron and steel industry for several years past, the results of his direction being shown in a 15 per cent. reduction in the fuel used per ton of finished product in that industry.

With regard to the building which it was proposed to erect for the purpose of housing various scientific and technical institutions—of which the Institute of Fuel was one—it was stated that H.R.H. the Prince of Wales had consented to make an appeal for the remainder of the money required, at a dinner to be held on November 13th, at the Guildhall, London.

In a reference to the extended use of gas, Sir David said it appeared to be well known that by reason of increasing mechanisation of industry and the greater use of power, the sales of electricity were advancing rapidly, but it was not so generally appreciated that there was a concurrent desire for efficient means of heating, which had resulted in the sale of gas increasing at nearly twice the rate of the electricity increase when referred to a common heating basis.

Gasworks, he continued, would increase their consumption of coal. For several years past the coal consumption by the gas industry had remained at 18 million tons per annum, on account of the use of plant of improved efficiency. As the plant was becoming highly efficient throughout the country, however, further increases in the gas production per ton of coal could only be small, and a demand for coal increasing with the demand for gas was to be expected in future.

Another matter to which Sir David referred in the course of his review of fuels was the increasing consumption of coke. The Area Gas Supply Committee, in the course of its examination of the conditions in the town's gas and coke oven industries, had found that, when coke was properly prepared, there was a wide domestic market awaiting it, whilst the adoption of modern coking plant would also result in savings of great importance to the competitive power of the iron and steel industry. Coke for domestic and industrial use had shown an increased demand of 400,000 tons last year, and that was attributed to the care taken in sizing and cleaning. Further work was in progress to improve coke quality by preparation of the coal before carbonising. In three years the Gas

Light and Coke Company had spent £400,000 on coke preparation plants.

As to the future of smokeless fuel, he said that plants which could secure good slack at low prices and sell the coke at good prices could show a profit. Other plants at a distance from the coalfields could not find sufficient margin to meet operating expenses. There was a market for low-temperature gas and coke, but the oils had proved disappointing in quality and value, as also had ammonia. Until the cracking or hydrogenation processes to improve these oils was perfected, on a commrcial basis, there was no hopeful future for any low-temperature process, principally devised to make smokeless fuel. It was more probable that the smokeless fuel of the future would be prepared from selected, prepared, and blended coals by high-temperature processes.

With regard to home-produced oils, the proper organisation of the carbonising industries could produce 12 per cent. of the motor spirit and 25 per cent. of other oils now imported. It was necessary that the production of such oils be modified and controlled to produce the required properties. In the past too much attention had been given to oils resulting from carbonisation without reference to their having the desired properties. It was a matter for congratulation that the Admiralty was making trials of home-produced oils; other large users should follow suit.

British coal, continued Sir David, was the nation's cure for depression; there was no oil, brown coal or natural gas in the country, but our bituminous coal was of high quality, and for a century past it had been the foundation of our prosperity. To-day, as in the past, our success as a manufacturing nation must be based upon it.

After a reference to the growing practice of selling coal by guaranteed specification, he urged that a considered plan for co-ordinating and extending the activities of the carbonising industries, with proper linkage to electricity development, was necessary. This plan would also take into account the production of hydrogen for chemical industries and the home manufacture of oils and motor spirit.

Uses of Fuel Oil.

The Conference was resumed in the afternoon, when two papers were read and discussed. The first was by Mr. I. Lubbock, chief engineer, technical department, Shell-Mex, Ltd., on "Industrial Uses of Fuel Oil." The title of the paper, of course, indicates an enormous width of the field to be covered, since in some degree there are very few industries to-day in which fuel oil is not being used. The author therefore very wisely eliminated groups of important applications which are usually treated individually, such as the use of fuel oil for marine work—which, by the way, formed part of the symposium on Thursday, October 23rd, on fuel problems in the mercantile marine—and the internal combustion engine. Apart from these groups, moreover, some of the applications of fuel oil, such as the oil firing of steam locomotives or the internal combustion locomotive itself, necessarily require separate treatment, and therefore Mr. Lubbock confined his attention to a summary of the general industrial uses on land, and to those applications in which the advantages of fuel oil are only just beginning to be appreciated. In this way he referred to glass furnaces, the ceramic industry, metallurgical applications, cement manufacture, road-making plants, the enamelling industry, and central heating.

Referring to metallurgical applications, special reference was made by the author to three crucibles installed to deal with pure nickel castings, each weighing 360 lb. He apologised for stating that electric furnaces had been tried and failed, but that successful castings with oil fuel were obtained, the temperature of pouring being 1600 deg. Cent. In that case the direct fuel cost was of no importance, the great desideratum being quality.

As regards cement manufacture, Mr. Lubbock pointed out that there was one important works in this country operating two kilns on oil fuel, but he was not at liberty to disclose the details of the special process employed. On the other hand, the direct oil firing of cement kilns had been carried out for many years quite successfully in Mexico, Uruguay, Brazil, and more recently in India. Different oil-burning systems were used ranging from a single large locomotive type of steam jet burner to an ordinary compressed air burner, and, finally, a single large-capacity mechanical atomising nozzle. In the case of some of those kilns, a single burner to deal with as much as 2 tons of fuel oil per hour had to be designed. It was claimed that the oil fuel burning system, if installed with the plant as originally built, reduced the capital cost of the plant very considerably, as compared with solid fuel, and also working costs.

Some similar general information was given with regard to central heating, bakeries, cooking, &c., and the object of the paper was to call attention to the increasing applications of fuel oil rather than to give detailed technical descriptions of plants, although the paper contained a number of photographs and sectional drawings.

Mr. Harald Neilsen, in opening the discussion, said that he had known instances in which people using oil had reverted to the use of coal, and contended that when a standard powdered fuel was produced there was no reason why it should not carry out the various processes mentioned as efficiently as fuel oil.

Mr. J. S. Atkinson, in a written communication, pointed out that for all except the smallest types of furnaces oil was a more expensive fuel than producer gas. With certain exceptions, the furnaces described in the paper appeared to have burners of the low-pressure type, through which the whole or the greater part of the air required for combustion was passed. He believed that that was a necessity with such burners and it was not conducive to economy.

Mr. E. W. L. Nicol—London Coke Committee—commented upon the advocacy by the author of the use of imported oil, which was mainly of foreign origin, in place of our native coal and coke fuels, and urged the claims, on economic and other grounds, of coke, electricity and gas, the advantages of which, he said, were the absence of the need of any storage tanks and the smokelessness of burning. Moreover, they were derived mainly from British coal. In many cases oil fuel was often adopted, he said, to gratify a natural desire for progress, novelty, mechanisation and convenience, apparently regardless of cost, and he pointed out that gas coke at 32s. per ton, containing 12,000 B.Th.U. net per pound, was equivalent to 69,900 B.Th.U. per 1d. of cost, whereas petroleum fuel oil at 65s. per ton, containing 18,400 B.Th.U. net, was equivalent only to 52,800 B.Th.U. per 1d. of cost. He also drew attention to the great complication necessary in the use of fuel oil apparatus for central heating purposes as compared with the extreme simplicity of a coke-fired boiler.

Mr. E. C. Lowndes expressed disappointment that the paper gave no statistics of the consumption of fuel oil in Great Britain, and added that, whilst one or two of the larger coal distributing companies in this country had on their staffs experts ready to advise on the utilisation of coal, the marketing of coal had not yet been made a strong point in the coal trade of Great Britain. Despite the author's claim that fuel oil was the more economical to use in the instances mentioned in the paper, there was only one case in which the figure of the saving made was given.

Dr. C. M. Walter—Birmingham—drew attention to the statement in the paper that the direct fuel cost in one case of heating salt baths for the treatment of metals was 16s. per day when using oil, as against £4 per day when using manufactured gas, and remarked that those figures were out of all proportion to anything that had come within his experience. He asked for the cost of the gas per therm and also the cost of the fuel oil in the case mentioned. His own experience of salt bath heating was that he could get a higher thermal efficiency with gas than oil. Discussing a reference made in the paper to the use of oil burners for heating sheet rolls in a metallurgical works utilising the open flame type of medium air pressure burners, he asked if Mr. Lubbock had experienced any difficulty from local heating when playing an oil burner of that type on to rotating rolls. He had heard of difficulties in that connection, but did not know whether they had been overcome.

The Author, in the course of his reply to the discussion, said that he would not go so far as to say that every fuel oil burner in this country was guaranteed to burn without smoke or soot, but a properly designed, installed and controlled burner would give rise to practically no smoke. As to the B.Th.U. figures mentioned by Mr. Nicol, the B.T.h.U.'s were not the only factors to be considered, and there were instances in which the evenness of the temperature throughout the building might be regarded as of more importance than the cost of the fuel. As to the comments by Dr. Walter, all he could say was that the figures of cost of salt bath heating had been given to him by the manager of a works.

Then followed a short paper by Dr. E. W. Smith, dealing with coke breeze. Dr. Smith did not appear merely as a propagandist in favour of coke utilisation, but urged the need for improving the value of the solid products obtained from gasworks. He was emphatic that if all coke were reasonably low in ash and moisture and suitably graded, and if technically informed selling organisations were to be instituted on an ample scale, then the demand for coke would be insistent and imperative. He stated a case also for some standard nomenclature in order to obviate the general term "breeze," pointing out that the actual size of the breeze depended on the mesh of the last screen. He suggested, therefore, that there should be no such general term as "breeze," but that there should be ¾in. breeze, ½in. breeze, and ¼in. breeze, depending on the size of the last screen, and he also pointed out that there could not be a consistent demand at a fair price unless the quality of the material could be relied upon. Indeed, Dr. Smith, with ample knowledge of the conditions, lays it down that there is no economic coke breeze problem, but that there is a number of technical problems which have yet to be solved. In short, the paper was directed to those who produce coke breeze and impressed upon them the necessity for standardisation and improving the quality of their product in order to meet a market which was described as enormous.

In the course of the discussion Dr. R. Lessing again pleaded, as he has been doing for a long time, for an extension of coal cleaning having regard to the influence of dirt in coal upon the coke breeze produced in the gasworks.

Mr. E. W. L. Nicol spoke of the experience in London and the provinces in electric power stations with the use of the sandwich system of using coke breeze and coal mixed together, and referred to the smokelessness of the power stations of the Deptford and London companies, which had been recently visited by members of the Institute. Electrical engineers were, he said, among the shrewdest buyers of fuel, and they bought and used coke breeze because it paid them to do so. The London Power Company's new power station at Battersea was to be fitted with mechanical stokers operating on the sandwich system, and that afforded another opportunity of extending co-operation between the gas and electricity supply industries.

Mr. E. C. Evans, discussing coke breeze from the point of view of the iron and steel industry, said that it was really a nuisance in that industry, not so much because of its ash content, but because of its size. Therefore he was glad that Dr. Smith had suggested that coke breeze should be defined by size, because it was most important to specify size. Some coke produced in this country contained a high proportion of breeze below 1¼in. and 1½in., and if that were eliminated before the coke was charged into the blast-furnace a very considerable saving of fuel and a considerable increase of production would result.

Mr. J. D. Troup spoke of an instance of an experimental plant in Manchester, including a Lancashire boiler fired with breeze, which it was utterly impossible to work with a mixture of 50 per cent. of breeze and 50 per cent. of dust. When the dust was eliminated, however, the fuel output of the boiler was obtained without difficulty. Had Dr. Smith any experience of the use of gasworks coke in a Lancashire boiler?

Dr. Smith, replying to the discussion, said that he gathered that Mr. Evans was rather suggesting that the gas industry supplied the iron and steel industry with coke, but he did not know of any gas undertaking which supplied coke for blast-furnaces. He promised to publish the information asked for by Mr. Troup as to the use of gasworks coke in Lancashire boilers.

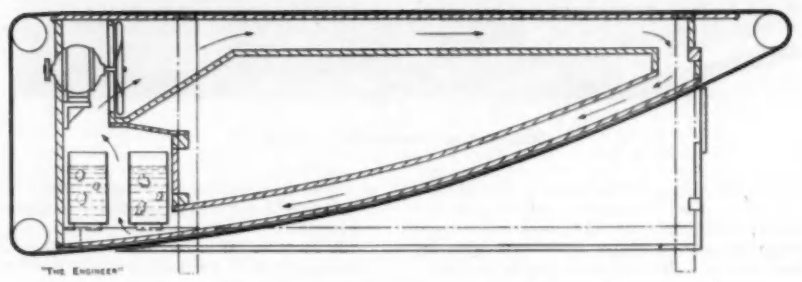
(To be continued.)

Photo-Printing in Hot Weather.

A disadvantage which has hitherto been experienced in applying the true-to-scale or Ordoverax system of copying drawings has been the fact that high atmospheric temperatures slowed down the process or even entirely prevented operations. This difficulty has, however, been overcome in the machine of which we give a diagrammatic section, that is being made by B. J. Hall and Co., Ltd., of Chalfont House, Westminster.

The difficulty encountered with the True-to-Scale process in hot weather is due to the softening effect of high temperatures on the gelatine coating that is used to take the first impression of the print that is subsequently inked with a roller and transferred to the print paper. This trouble begins to manifest itself at a temperature of about 75 deg. Fah., and is acute at 80 deg. As a consequence, the process has been practically debarred from hot countries on account of the expense of keeping the whole of the workroom at the appropriately low temperature.

The trouble has been entirely done away with by Messrs. Hall by cooling the table, on which the linoleum band carrying the gelatine surface is stretched. As shown in the drawing, the band is continuous and runs over three rollers, so that it can be moved forward to provide a new surface as one part is used up. It slides over a zinc-lined table, on which the printing is done. Beneath the table there is a system of trunking, made of plywood, round which a draught of air is blown by three small fans. One fan was tried at the outset, but was found to give too concentrated a draught, so three fans, side by side, were substantituted with the two outside ones driven by belt from the motor of the central fan. Just below the fans there are two light metal tanks in which ice is put to cool the air circulating.



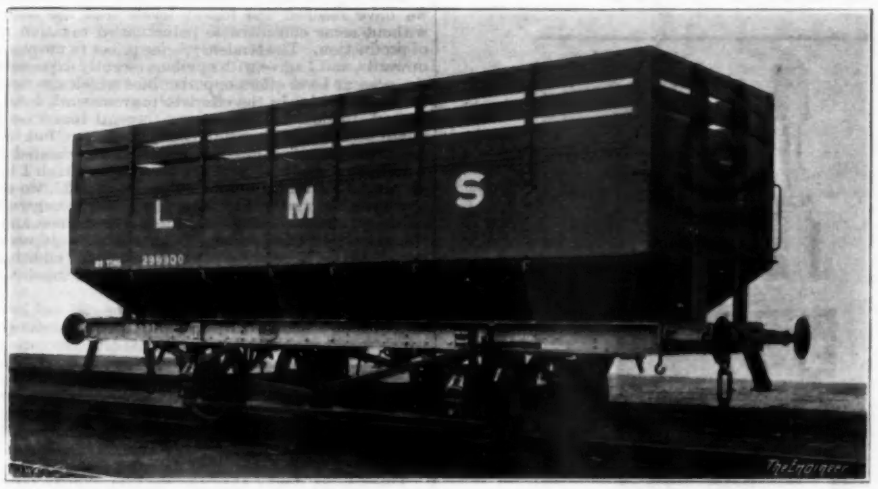
Air-Cooled Table for Photo-Printing in Hot Weather

The amount of ice required is not excessive, and amounts, we are told, to ½ cwt. a day when the room temperature is 70 deg., while it increases by about 10 lb. per day for every degree rise in temperature. With that expenditure of ice the consumption of electricity by the fans is negligible, and the table can be kept at such a temperature that work can be carried on continuously regardless of the weather, a fact which we determined ourselves during the recent heat wave. We understand that the makers are about to produce a table with its own refrigerating apparatus for use in places where ice is not obtainable.

The Institution of Mechanical Engineers: Awards to Graduates.—The following awards have been made by the Council of the Institution of Mechanical Engineers for papers read before the Graduates' Section of the Institution during the session 1929–30:—Mr. C. S. T. Paul (student), prize to the value of £6 for his paper on "Propeller Type Water Turbines;" Mr. John Dearden, B.Sc. (graduate), prize to the value of £4 for his paper on "Compressed Air and its Application;" Mr. A. B. Winterbottom, M.Sc. Tech. (graduate), prize to the value of £2 for his paper on "Some Recent Developments and Protective Coatings and Treatments Used to Combat Corrosion and Abrasion;" Mr. J. C. Sahney (student), prize to the value of £2 for his paper on "Impact Effects in the Design of Bridges."

Glass Silk for Heat Insulation.—The manufacture of glass silk for heat insulation has been begun by Chance Brothers and Co., Ltd., at their Firhill Works, Glasgow, N.W. This material has for some time been extensively used on the Continent in the field of high temperatures and pressures, both in steam and internal combustion engineering. It is unaffected by any degree of cold and will withstand temperatures up to 900 deg. Fah. for any length of time. It has a coefficient of thermal conductivity at least as low as any other material suitable for steam temperatures, and lower than most. In addition to the foregoing, the following attributes are claimed for it:—It is very resistant to vibration; it is superior in weight to any other insulating material which will withstand high steam temperatures; it is non-hygroscopic; it is incombustible and will not cause or assist fire; it is chemically inert and it is unaffected by any materials or acids, saving only hydrofluoric acid; it is odourless and hygienic, and will not rot or putrefy. Messrs. Chance Brothers have, besides undertaking the manufacture of glass silk, laid down special plant for testing the insulating efficiency of the material in different forms and under various conditions so that they might be in a position to make tests upon and to recommend the form or forms most suitable for particular applications.

L.M.S. RAILWAY—20-TON STEEL HOPPER COKE WAGON



L.M.S.—Hopper Coke Wagons.

The L.M.S. Railway Company has recently put into service one hundred 20-ton coke wagons of the steel hopper type, fitted with eight bottom doors, which are independently operated. The construction of the body is designed to enable the load to be entirely self-discharged through the bottom doors merely by the removal of French keys securing the doors.

The sole bars and headstocks of this wagon are of channel section 10in. deep, and the longitudinals consist of ⅜in. thick steel plate strengthened by means of 3in. by 3in. angle steel. A cross bar directly above each wheel connects the longitudinals, both being girder section 10in. deep. The whole frame is well strengthened by angle knees and gusset plates.

The buffing gear, drawgear, wheels and axles, axle-boxes, brakework, &c., are all to R.C.H. standard 20-ton drawings. The brake is of the double type and gives a leverage of 30 to 1.

The bottom portion of the hopper is built of ¼in. steel plate. The side sheeting is of $\frac{5}{16}$ in. steel plate, and a greater loading capacity is obtained by means of three timber rails 1½in. thick, secured to 22in. by ⅜in. flat steel bars, which, in turn, are riveted to the side sheeting of the hopper.

The principal dimensions are as follows :—

Length over buffers	28ft.
Length over headstocks	25ft.
Wheel base	12ft.
Diameter of wheels	3ft. 2in.
Size of journals	10in. by 5in.
Overall height	11ft.
Load	20 tons
Capacity	1380 cubic feet
Tare	11 tons 5 cwt.

The Art of Concrete Making.

In his presidential address to the Institution of Structural Engineers, which was delivered on October 23rd, R. H. Harry Stanger, F.C.S., A.M. Inst. C.E., after reviewing the origin of the standard specification for Portland cement and other matters went on to discuss the art of concrete making.

The tests laid down in standard specifications were, he said, the result of co-operation between the scientist and the manufacturer, but while it had become the practice to specify that the materials used in constructions should comply with the requirements of standard specifications, where such existed, it should also be possible to ascertain the qualities of the materials from the structural engineer's point of view.

To know that the cement which went into his concrete attained a strength of 472 lb., when mixed with sand which had been specially prepared and graded, was not very helpful, if he was called upon to explain the failure of that same concrete. What he did want to be able to assure himself of was that his concrete was strong and dense and that it would remain strong and dense for many years.

"I am inclined to think," went on Mr. Stanger, "that concrete is the structural engineer's best friend, but, like all true friendships, it is essential that he should be able to understand it in all its moods.

"I trust that I may be forgiven if I say that up to recent times the structural engineer has been accustomed to work by tradition. He was satisfied if the cubes of concrete sent to the laboratory showed the strength laid down in his specification. If the contract was of sufficient importance, he might, before the commencement, have the aggregates which he proposed to use sent to the laboratory for making into cubes and testing for compressive strength. The fact that cubes made on the job always gave lower strengths than cubes made in the laboratory was certainly disquieting, but, as it invariably happened, this difference came to be looked upon as something only to be explained by the fact that the laboratory, for some insidious reason, was always supposed to try to obtain the greatest possible strength. Actually, the difference was due to the controlled conditions in the laboratory, and as this became recognised, efforts were made to introduce more exact control in the field by the improvement of the machinery for the better mixing of the materials and for the smoother depositing of the finished product. These, however, are but a minor part of the craft of the concrete maker.

"By far the most important is the knowledge how to make proper use of the materials at hand to meet the particular requirements in view, and this may well be called the Art of Concrete Making. I cannot do better than quote from a recent publication of the Building Research Station which touches on this subject :—

"'Little progress can be made in the development of a science of building to replace the present shaky foundation upon which building methods have been formed until the vagaries and eccentricities of materials of construction have been eliminated by standardisation. Standardisation, however, is but one step forward. It is then necessary to devote the results of scientific investigation to the evolution of proper methods of using materials, and to making possible the ready adaption of such methods with a change in conditions, an objective which can only be reached in co-operation with an industry the members of which have been educated to make the most of the results of research.' Here it is that the closer co-operation is needed between the engineers and the scientific research investigator.

"The research laboratories of the world have done an immense amount of work to show how greater scientific methods of control can help in getting the best out of the improved methods of manufacture, and most engineers have been quick to adopt their suggestions. Possibly the greatest advance has been the enunciation by Duff Abrams of the law of the water-cement ratio, by which the resulting strength of the concrete can be predetermined. One of the problems of this art is the problem of workability, which is dependent most frequently on the grading and shape of the aggregate, and not, as is so often stated, on the quantity of water used. How often does one see in contract specifications a clause calling for the use of clean sharp aggregates; indeed, some of us would appear to be wedded to the sharp aggregate, whereas it is possible that a rounded aggregate would work much better, use less water, and be just as good in strength and density.

"Chemists tell us that Portland cement is a 'gel' material, and subject therefore to volume changes when the moisture content changes. That being so, it would appear that the engineer has it in his power, by a proper knowledge of the effect of curing, if not to eliminate, then certainly to control those movements which bring about the cracking and crazing.

"The improvement of this art must mean the transfer to practical work of the technique of the laboratory. How is this to be brought about? The universities and engineering colleges equipped with splendid research laboratories are doing a great work in the investigation of many of these problems, but so far as I am aware, no appreciable facilities are offered for the specialised teaching which the Art of Concrete Making now demands. I feel that here is an opportunity for our Institution to lead the way, by arranging for courses to be given, not only here in London, but also at our branch centres—courses at which the modern ideas on the subject would be expounded.

"At first, as I see it, the course would have to deal with the subject from a general point of view; later on, as the teaching of the art improves, courses should be held at which the results of up-to-date research work would be brought to the notice of the practical engineer.

"I suggest that our older members and even those who know all about concrete would not be wasting their time if they were to attend these advanced courses, which for want of a better name might be called 'refresher' courses. In this manner we shall do much to carry out the first object mentioned in the Memorandum of Association of our Institution, which shows that we are established to 'promote the science and Art of Structural Engineering in any or all of its branches.'"

The Quick Replacement of a Railway Bridge.

What is claimed to be a record in railway bridge replacement was recently effected by the Pearson and Knowles Engineering Company, Ltd. The scene of the achievement was Carr-lane, Norris Green, Liverpool, where a 500-ton steel bridge was substituted for a 100-ton structure that carried the Cheshire Lines Railways' Southport line over a road which, having been widened on each side of the railway, constituted a dangerous "bottle neck."

A gang of platelayers removed the old railway lines during the night of October 4th, so as to enable the engineers, who were conveyed from Warrington in motor coaches, to begin operations on Sunday morning, October 5th, at 5 a.m., in the light of flares. By means of eight Tangye hydraulic jacks the old structure was raised clear of its stone abutments and the weight transferred to six steel trestles mounted on a special rail track laid in the roadway below. At 5.35 a.m. the men began to haul out the old bridge and in 20 minutes it stood on the trestles 45ft. up the roadway from its original position.

An hour was then occupied by the masonry contractors in tearing down the stonework which had previously supported the old bridge so as to clear the way for the new bridge, which had been built and riveted on massive trestles parallel with the structure to be replaced. On these trestles were special carriages, coupled up to hand winches by blocks and steel hawsers, to convey the new structure into position. The process of hauling the new bridge into position begun at 6.50 a.m., and at 7.30 a.m. it had been successfully accomplished. Hydraulic jacks, each capable of lifting 100 tons, were then brought into operation. The West Derby end of the structure was lifted first and the carriages on which it had been carried were displaced. Rocker bearings, each weighing 5 tons, were then drawn into position on the new abutment, and at 9.25 a.m. that end of the bridge had been lowered on to its permanent seatings. The calculations of the engineers were of such accuracy that the new bridge fitted exactly into the position intended for it without any further adjustment being required.

Efforts were then concentrated on the opposite end of the bridge. Similar jacks were used to lift the bridge, and the carriages were removed as at the first end, so as to allow the masonry contractors to fix the pre-cast concrete blocks which support the rail bearers. The expansion bearings were then fixed, and the bridge, on being lowered, fitted truly into its correct position.

The platelayers lost no time in coupling up the permanent way and a trial train was run over the bridge during the early afternoon, the whole operation having been completed well in advance of the time scheduled for the resumption of railway traffic.

The new bridge, which was fabricated by the Pearson and Knowles Engineering Company, Ltd., in its works at Warrington, has a length of 133ft., a width of 31ft. 6in., and a depth of 23ft. 6in.

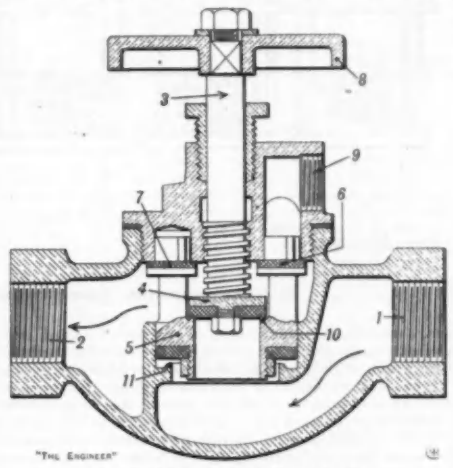
The actual time taken for the bridge-moving operations, after deducting the time occupied in masonry work, is as follows :—

	h.	m.
5 a.m. to 5.50 a.m.	0	50
6.50 a.m. to 10.15 a.m.	3	25
11.15 a.m. to 11.20 a.m.	0	5
	4	20

The operations were under the control of Mr. Edward Massey, consulting engineer, and Mr. W. Price, chief erector.

A Self-draining Stop Valve.

The valve illustrated herewith has been designed and patented by Mr. L. N. Hirst and is being manufactured by Newman Hender and Co., Ltd., of Woodchester, Glos., for British Overhead Irrigation, Ltd. The type



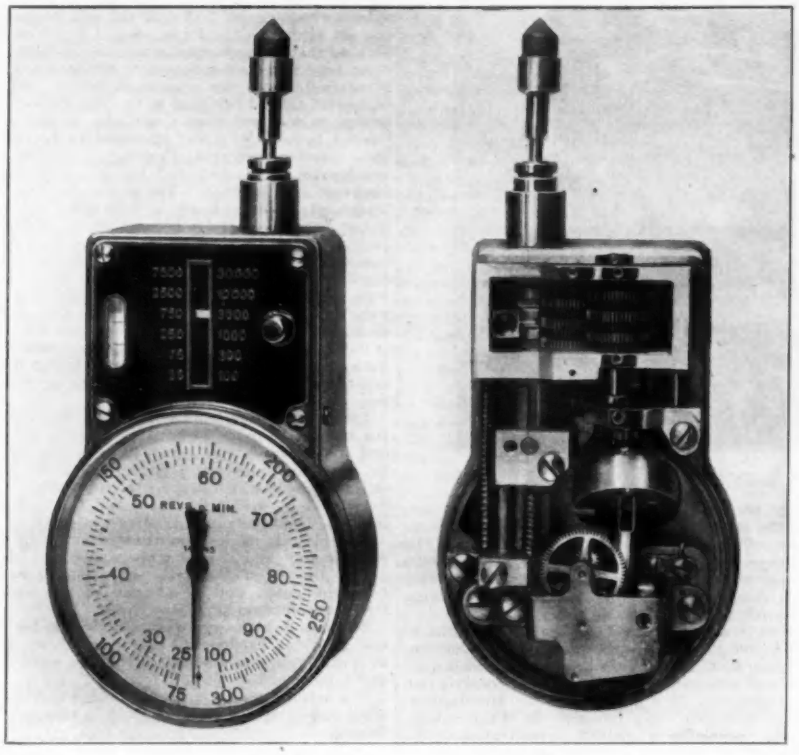
SELF-DRAINING STOP VALVE

shown is suitable for water supply at a pressure between 30 lb. and 100 lb. per square inch, but we understand that the valve can be made for any pressure of water, steam gas, oil or air. It will be observed that the pressure of the supply operates the closing of the drain valve, and keeps it closed, before any water can enter the service system. It is thought that the valve should be useful on steam-heating systems, as it would ensure that the pipes were free of water before steam was turned on. The following description makes the action clear.

On hand wheel 8 being turned in an anti-clockwise direction spindle 3 is lifted, thus relieving mechanical pressure on main valve 4 and piston 5. Water pressure entering inlet 1 forces piston 5 and valve 4 upwards until piston 5 reaches the limit of its travel. This limit is reached when the small drain valve 6 and compensating guide 7 are on their seats, in which position the valve is as shown in the attached drawing. The travel of main valve 4 is continued until the valve is full open to outlet 2, the drain valve 6 being held on its seat by pressure of the supply on the underside of piston 5. When the valve is closed, piston 5 is forced downwards by valve 4 under action of spindle 3, so withdrawing the drain valve 6 from its seat and allowing all water remaining in the system—on the outlet side of the valve—to drain away through the drain outlet 9. When the valve is closed the leather face of the main valve is forced on to seating 10, and that of piston 5 on to seating 11, thus entirely shutting off the water supply.

SIX-SPEED HAND TACHOMETER

GEORGE THOMAS AND CO., LTD., MANCHESTER, ENGINEERS



A Six-Speed Hand Tachometer.

A NEW hand tachometer of an improved type operated on the well-known pendulum or governor weight principle, but incorporating special features of merit, is now being introduced by George Thomas and Co., Ltd., Manchester. Hitherto, although it has been possible to obtain tachometers with three or four trains of gearing to cover a fairly extensive range of speeds, a need has been felt for an instrument which will cover the whole range likely to be met with in large works. The instrument illustrated herewith meets this requirement by the use of a sliding gearbox of novel construction and enables speeds to be counted from 25 revolutions to 30,000 revolutions per minute. The drive from the main spindle is taken through a train of gears and finally to the pendulum spindle of the indicating mechanism, as shown in the diagram above. The four highest gears are engaged by the movement of the main spindle and pinion which is fixed to it, and the two lowest ranges are obtained by the further inward movement of the spindle and the gear-box which contains the whole train. The six alternative gears thus obtainable give the following steps :—25–100, 75–300, 250–1000, 750–3000, 2500–10,000, and 7500–30,000.

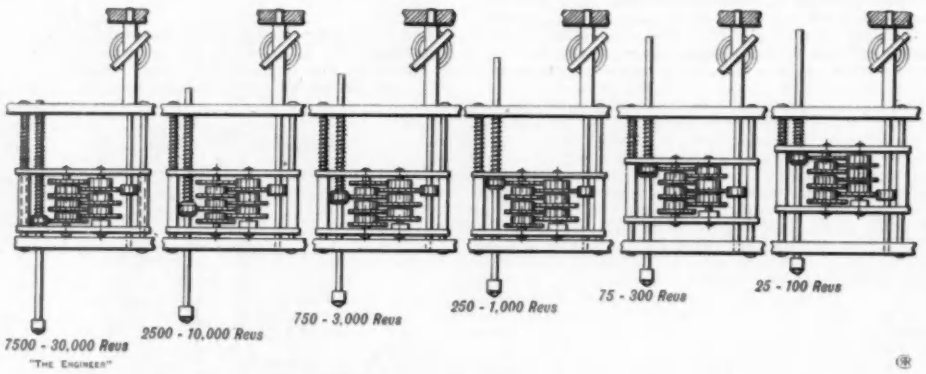


DIAGRAM SHOWING DISPOSITION OF GEARS FOR DIFFERENT SPEEDS

An interesting and useful feature allows for a positive foolproof gear change. It has been possible with previous instruments unintentionally to engage a lower gear than that which should have been used, because the change could be freely made. The indicating mechanism could thus be accidentally strained, with consequent damage to the instrument by the overrunning of the speed capabilities of the pendulum. A special locking arrangement could be provided, but it necessitated the use of both hands when testing. In the new instrument the gears are positively locked in position until disengaged by pressing a small stud, which then allows a change of gears as required and immediately locks them on releasing the stud ; the instrument can also be held easily in one hand and the push stud depressed by the thumb as and when the gear is to be changed, thus leaving the other hand free.

The instrument is not affected by temperature variations, magnetic currents, or the position in which it is held, so long as the axis of the instrument is in line with the axis of the part under test. The usual spirit level is incorporated in the body of the instrument, and the gear in actual use is plainly shown by the indicator between the speed range figures, which are of raised metal on a black ground. The scale indication is clear and an accuracy of within a half of 1 per cent. is claimed.

The instrument is supplied in a leather-covered case with all necessary accessories, including surface speed discs, making it suitable, not only for revolutions of all machines or parts thereof, but also for circumferential speeds and surface speeds of belts and cables, &c. The weight of the instrument is about three-quarters of a pound and with the box and accessories about 1¼ lb., while the diameter of the dial is 2¾in.

The Shipbuilding Industry.*

IN surveying the organisation of our industry as a whole we have to face problems which are somewhat outside the orthodox subjects dealt with by this Institution ; my remarks will be limited accordingly. We cannot blind ourselves to the fact that the supply facilities for engineering and shipbuilding are much in excess of present demand, and even future prospects ; so much so that a recent presidential address to an important shipping conference contained the suggestion that the building of ships should stop temporarily. We have, therefore, proposals for the scrapping of older and less efficient vessels, for restrictions on the sale of certain ships to foreign competitors, and the reorganisation of our industry by permanently closing down some proportion of these establishments. To those who believe that supply is governed by present or prospective demand, some inconsistency would appear to characterise certain of the remedial measures suggested. Nevertheless, the alternative is to trust to "the survival of the fittest," and if we can intelligently anticipate this process by the elimination of redundant establishments, rationalisation deserves earnest consideration.

We recognised that part of our present difficulties may be traced to the building of tonnage abroad by the aid of subsidies or by lower wages, although we do not presume to criticise the policy of our foreign competitors in this respect. Any control of our output or prices must be considered with respect to its effect on foreign orders which come to this country, and the likelihood of such work being diverted elsewhere, and here the difficulty of securing international agreement is obvious.

With regard to the movements of prices, I believe that we have reached the lowest levels that are attainable without some considerable reduction in taxation or cost of production. The tendency is for prices to move steadily upwards, and I agree with opinions recently expressed, that the present level offers opportunities which are not likely to be repeated. In the effort to prevent work from going abroad, tenders have been put forward based on inadequate percentages for establishment charges, but in many cases this sacrifice has not achieved the desired result. As I have already pointed out in a paper which I had the privilege to submit to this Institution in 1927, we are tied down to a large extent by factors outside the control of the industry, such as taxation, national insurance and compensation ; further, numerous items in the equipment of a vessel are still relatively expensive. In addition, the specification for the actual ship herself is usually appreciably more costly than in pre-war days.

I believe that some savings might be effected by a process of semi-standardisation of ship types and dimensions, which would enable the cost and time of construction to be shortened ; but the strongly individualistic tendencies of shipowners and their superintendents place a limit on what can be achieved. We have progressed some way in this direction through the activities of the British Engineering Standards Association, but there is still much that might be accomplished, notably in those fittings of which every shipyard has its own different "standard."

There is no doubt that the modern ship is capable of carrying more efficiently than pre-war vessels, particularly so if comparisons are effected on the basis of gross tonnage. Not only has the average size of vessel increased almost 30 per cent., with a corresponding increase in economy, but the speed, both actual and in proportion to size, has increased. The large proportion of oil-burning tonnage, with consequent reduced bunker space losses, must be considered ; a motor vessel may lift 10 per cent. to 15 per cent. more actual cargo than the coal-burning steamer. As the actual oil-burning tonnage afloat to-day amounts to some 41 per cent. of the total, and of this about 29 per cent. is propelled by motor engines, it will be seen that the potential carrying capacity has been vastly increased by technical progress. Further, such matters as improved port facilities for loading and unloading, average length of voyage, &c., all favour the carrying capacity of the modern vessel.

The advent of oil fuel has had a profound influence on shipping through its displacement of a large amount of the faster, better-class, coal-burning tonnage, coupled with an enormous reduction in the demand for transport of bunkers to overseas depôts. The change over to oil burning has been encouraged, especially in the case of some continental countries accustomed to purchase coal from Great Britain, by the unrest in the coalfields. At present it is by no means a one-sided battle between coal and oil ; each has its proper share of employment, but for a very large number of routes I think we may safely choose the coal-burning steamer. With the higher steam pressures available and modern machinery, including some form of mechanical stoking, the coal-fired steamship offers the cheapest method of propulsion available to-day.

There would appear to be very considerable economies to be obtained by the use of high-pressure superheated steam plants, particularly for moderate and large-power outputs. The results already achieved in service by the latest units of the Canadian Pacific Steamship Company are unequalled by other prime movers, and these installations have the advantage that conversion from oil to coal or *vice versâ* may be made according as the prices of the respective fuels render this desirable.

The method of firing is naturally of considerable moment, and pulverised coal apparently offers a possible increase in efficiency. This particular system is receiving much attention at present, although it is experiencing the usual "growing pains" inseparable from the essential gaining of experience under sea conditions. Our country possesses such large deposits of coal that further progress and development of pulverised coal as well as mechanical stoking plant is most desirable for the maintenance of our coal industry.

* From Mr. John McGovern's presidential address to the North-East Coast Institution of Engineers and Shipbuilders, October 24th, 1930.

GENERATION OF ELECTRICITY.

As the outcome of the publication of their monthly statements showing the number of units of electricity generated by authorised undertakers in Great Britain, the Electricity Commissioners have been asked whether corresponding monthly particulars for the past two completed years could be made available for comparative purposes.

The desired figures are set out below :—

Month.	Units Generated by Authorised Undertakers (Approximate Figures).		
	1928.	1929.	1930.
	Millions.	Millions.	Millions.
January	865	1033	1072
February	791	938	982
March	816	873	963
April	670	807	837
May	694	753	818
June	630	694	709
July	635	732	786
August	624	706	721
September	670	755	—
October	838	949	—
November	895	1005	—
December	945	1049	—
Totals	9,073	10,294	—

It will be noted that in each month in 1929 the output (units generated) showed an increase over the output in the corresponding month of 1928. Similarly the output in each of the first eight months of 1930 showed an increase over that in the corresponding months in 1929.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Will Iron Prices Fall?

The pig iron situation has provided the chief source of interest on 'Change in Birmingham this week, and as I write this letter speculation is rife as to whether the next few days will bring a lower range of prices for Midland pig irons. Continental pig iron has now definitely made a reappearance in South Staffordshire. Merchant houses offer Luxemburg foundry pig at £3 7s. 6d. delivered in the Birmingham district, a figure half-a-crown lower than the cheapest Midland iron. It is stated that some small tonnages have been delivered here, and that others are expected. The business done, however, does not appear to be of great magnitude so far. Local foundrymen say that the quality, judged by analysis, is not much below that of the standard of Northamptonshire pig. They are so incensed against the unfavourable terms which they aver are demanded by Midland blast-furnacemen that they intimate that unless pig iron prices are speedily reduced they may take organised action. Foundrymen say that not only are they asked prices which are unjustifiably high, but also state that they believe that they are being treated worse than their South Wales competitors. Though the carriage from the central furnaces to South Wales is 50 per cent. more than to the Midlands, foundrymen here declare that cost at consumers' works is in favour of South Wales. The Central Pig Iron Producers' Association is maintaining a firm hold upon prices, but this week it will have its monthly meeting, and foundrymen are hoping that price concessions will follow. So far the smelters have given no inkling as to their possible intentions, but it is just as likely they will repeat their action of July, which effectively put continental pig out of the running. An all-round reduction of half-a-crown per ton would probably bring that about, though it is doubtful if it would fully appease the angered Midland foundryman. All attention is now focussed on the furnacemen's meeting, and on the result of the deliberations thereat.

Steel.

Sales of British finished steel in this district are no more weighty than they have been in recent weeks. Most Midland structural engineers are short of orders, and their demands are easily met. General engineering continues quiet, rolling stock firms are not doing so well as they might be, the tube trade is decidedly slack, while motor engineering firms have not yet got down to the season's production. Normally, in the autumn, the call for steel should be much improved on that of the summer, but, as a matter of fact, the dullness which has characterised trade practically throughout the year is, if anything, more pronounced. Severe continental competition has, of course, something to do with the present situation. Importers' quotations are still exceptionally low. Structural steel, such as joists, show a difference of over £3 per ton when compared with local makers' prices. Steel consumers not parties to the steel rebate scheme have in many cases bought well, and some of them are now inquiring from the foreigner his lowest terms for supplies of steel over the rest of the year. They consider that continental prices are now at or very near to bottom. Local steelmasters are bound to feel the effects of this buying in a cheap market, and it is doubtful whether some of the works now only operating three days a week will be able to maintain even this measure of activity. Fortunately, the position is not so bad for the mills producing free-cutting steel, carbon steel and other special lines. The call for these and also for stainless steel is expanding. A number of motor car engineers are now using the latter material for radiators and external fittings on their latest models. In the semi-finished branch foreign competition is making great headway, and district steel masters are able to make sales only with difficulty. Re-rollers here offer small bars at £7 12s. 6d., while billet makers quote £5 15s. delivered for their products. Small steel bars from the Continent are to be had at £5 5s. and billets at £4 7s. 6d. or less.

Staffordshire Bar Iron.

One or two Staffordshire makers of bar iron intimate that a few more inquiries and orders for best grade iron are being received. That, however, is not the general experience, and business throughout the industry as a whole remains most unsatisfactory. Local producers experience considerable difficulty in finding regular work for their plant, and the problem becomes more involved each week. For high-class engineering purposes best Staffordshire marked iron is always in request, and ironmasters are able to command £12 10s. per ton for their output. The Crown bar branch finds trade more abbreviated than ever, and the selling figure of £10 7s. 6d. is only in rare instances paid. Makers who are prepared to accept orders at £10 per ton get little support, and it is evident that consumptive demand is wanting. Makers from outside districts who are prepared to sell at cheaper rates appear to be no better off for work than are their Staffordshire confrères. Nut and bolt bars at £9 per ton are in little request. The consuming industries in this area are poorly employed, and have an obscure outlook. The demand at date is chiefly for bright nuts, bolts and screws made from steel and utilised in the electrical industry. Producers of iron strip continue to receive a number of small orders. Trade has fallen away immensely of late, and even a lower price level has failed to stimulate demand. Quotations are unchanged at £10 17s. 6d. per ton delivered.

Galvanised Sheets.

Home demand for galvanised sheets is maintained at recent levels, and some firms this week report slightly improved buying on account of overseas markets. Tonnages continue unsatisfactory, however, and it is evident that consumers are unwilling to contract forward. Prices are unchanged on the basis of £11 12s. 6d. per ton f.o.b. for 24 gauge corrugateds. Black sheets are selling rather better to automobile engineers, and development in this branch in the near future is anticipated. Values are unchanged.

Scrap.

Very little, if any, steel scrap is changing hands just now. In many cases steel works have suspended further deliveries, having considerable quantities in stock. Birmingham merchants are unable to find buyers even at cut rates. Prices are nominal.

Warwickshire Miners' Decision.

At a meeting of the Council of the Warwickshire Miners' Association on Thursday last week, the letter from the Warwickshire Coalowners' Association, to which I referred in my last letter, and which suggested that in view of the Mines Act the agreement made in 1927 between the two associations should terminate, came up for consideration. Delegates were present from all parts of the county. The meeting was private, but it was announced that the following decision was arrived at: "That the 7½-hours Act should operate from December 1st, and that wages should remain as at present, with an increase of 7·1 per cent. to pieceworkers to compensate them for reduction in working time. It was considered that no further alteration of the wages agreement of 1927 should be made, except the substitution in Clause 1 of seven and a half hours for eight."

Obituary.

The death occurred on the 26th inst. at Edgbaston, Birmingham, of Mr. Walter E. Pearson, the well-known ironmaster and *habitué* of the Birmingham Iron and Steel Exchange. Mr. Pearson, who was in his sixty-ninth year, entered the business of his father at Netherton Furnaces, near Dudley, being ultimately taken into partnership, together with his brother, Mr. J. F. Pearson. Later he succeeded his father on the directorate of the Granville Colliery Company, Ltd., near Burton-on-Trent.

Increased Unemployment.

Unemployment in the Midlands area has increased in a week by more than 4000, more than wiping out the recent slight decreases and bringing the total up to 290,643. The wholly unemployed number 184,621, temporarily stopped 105,565, and normally in casual employment 457. A week ago the total was lower by 4244 than it is at date, while the figures are an increase on the corresponding week last year of 135,589. To the total, Birmingham provides 51,902, Stoke-on-Trent 25,473, Nottingham 12,336, Leicester 12,216, and Wolverhampton 11,824. Coventry's figure of 9641 is roughly 200 in advance of a week ago. Six Black Country towns record increases and six decreases, among the latter being Wolverhampton, West Bromwich, Smethwick, and Oldbury.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

A Two-Counties' Coal Merger.

Quite the biggest thing in British coal trade mergers now seems to be assured, although important details have still to be discussed. The vital step was taken at a meeting this week of Lancashire and Cheshire coalowners, and the ultimate realisation of the scheme is almost a foregone conclusion. In a few words, the object is the control by one body of the whole of the industry of the two counties. In round figures, the aggregate output is rather more than 15,000,000 tons, the capital £25,000,000, and the number of workpeople employed by the constituent concerns, something like 80,000. The actual decision may have come as a complete surprise to a good many people, but it is known that negotiations have been proceeding quietly for some time, the ground having been largely prepared during the past year or two, first by the formation of Manchester Collieries, Ltd., and more recently by the formation of the Wigan Coal Corporation, these two groups between them having a capital of £7,250,000. Several other mergers in the Lancashire coal industry have been effected, but the two named are the most important, and the experience already gained by them will, doubtless, prove of great value in preparing the larger scheme. Primarily, of course, the aim is to effect substantial economies in both mining and marketing.

Machinery for Russia.

Although up to the present the news is essentially vague, there is ground for believing that a movement is afoot to attract substantial Russian orders for machinery to Lancashire. Credits are the keynote, as they have been throughout the post-war years in respect of Russian trade, but it is hoped that a scheme will be evolved by which it will prove possible to secure welcome additions to the order books of Lancashire engineering concerns. In the past Russia provided big orders for textile machinery firms, more particularly in the Oldham area, and if satisfactory credit terms can be arranged, substantial business is expected for an industry which, during the past year or two, has experienced more than its share of difficult times.

A New Bridge.

A new bridge forms part of a road programme, to be completed by the end of 1933, which has been agreed upon by the Manchester Corporation and the Cheshire County Council. The bridge is to be built by the County Council across the river Mersey at the city boundary near Jackson's Boat, and half the cost is to be borne by Manchester.

University Appointments.

Recent Manchester University appointments include the following:—Mr. W. Jackson, Lecturer in Electrical Engineering; Mr. J. C. Takden, at present Assistant Lecturer, to be Lecturer in Mechanical Engineering, and Dr. R. H. Grundy, and Mr. J. R. Whittaker, to be Assistant Lecturers in Mechanical Engineering. In consequence of his appointment as head of the Department of Building in Birmingham Technical College, Mr. G. J. Grantham has resigned his Assistant Lectureship in Building Construction in the Faculty of Technology at Manchester.

Non-Ferrous Metals.

The all-round improvement in the non-ferrous metals market noted a week ago, has proved to be a "flash in the pan." Tin, it is true, has consolidated its position very slightly, but in all other respects the whole of the ground previously gained has been lost, whilst in the case of copper a new "low" has been touched. It is now obvious that any hope of a return to stable conditions which may have been raised by last week's spurt, must be postponed. In copper, the basic fact remains that the demand for the metal is still appreciably below the curtailed output, and whilst speculative interests may at times succeed in initiating a "bull" movement, the latter, in the absence of some measure of equilibrium between supply and demand, is likely to be short-lived. On balance for the week, standard copper has lost about 30s. a ton. Tin has failed to maintain the highest point touched, though prices have finished up 10s. a ton above last week's parities, largely on the strength of the belief that a gradual improvement in the statistical position of the metal will be experienced. The demand for spelter has been quiet, and the week's loss of about 12s. 6d. a ton has brought prices back to where they were a fortnight ago. This has also been the experience of lead, sales having undergone a contraction, and values having eased off to the extent of 10s. a ton.

Iron and Steel.

Relief to the depression in the iron and steel trades locally seems to be as far off as ever. Pig iron deliveries leave much to be desired and are certainly on no bigger a scale than they were during the late summer months, even if they are not actually below. How far the "autumn revival" has materialised can easily be judged. So uncertain is the price outlook in this, as in most other sections of the market, that users, in placing new business, have fallen back on what is little more than a week-to-week basis. Up to the present Staffordshire and Derbyshire brands have been maintained at 72s. per ton for delivery to users in the Manchester zone, forge quality being quoted at 5s. less. In the absence of buying, Scottish iron lacks strength, and values for delivery in the Manchester district have eased to about 91s. per ton, although hematite at 84s. 6d. is much the same as before. Lancashire bar iron keeps up at £10 5s. per ton for Crown quality and £8 15s. for seconds, but the demand for this material continues on a restricted scale. Unsatisfactory conditions continue to rule in almost every section of the steel market, especially in the heavy materials. Requisitions against old contracts are being received by rollers for limited quantities, and in pretty well every instance new business is being handed out on the basis of rolling programmes. Locomotive builders, constructional engineers and boilermakers in the district are, with few exceptions, poorly engaged. There is some weakness in small re-rolled bars and in boiler plates, but otherwise values are unchanged. Re-rollers are now offering small bars at from £7 7s. 6d. to £7 10s. per ton, and boiler plates are easily obtainable at £9 10s. Ship plates are at £8 17s. 6d., sections at £8 7s. 6d., joists at £8 10s., and large bars at £9 7s. 6d.

Institution of Electrical Engineers.

At the opening meeting of the North-Western Centre of the Institution of Electrical Engineers, held in Manchester on Tuesday last, the chairman, Mr. A. L. Lunn, M.I.E.E., M.I. Mech. E., gave his inaugural address, entitled "An Engineer's Outlook: Present and Future." One of the points mentioned was the importance of adequate training. Mr. Lunn said that the engineer of to-morrow will have to be far better equipped mentally than his predecessors. In recent years difficulties had unquestionably been met in securing suitable men for the higher positions in the industry. There was an undoubted scarcity of men whose training and experience had given them that wide grasp of affairs which was so essential in the management of large undertakings. He said that much leeway will have to be made up by this country in the use of electricity to catch up with several European countries and with the United States. The industry had been handicapped by haphazard development. Perhaps the most interesting economic change that the extension of electricity to all parts of the country would bring about was the decentralisation of industry and with it the resuscitation of local industries. Ultimately, there would be a widely extended use of electricity for railway traction, both for passenger and goods traffic. This would be brought about by the Central Board supplying electricity direct to the railways from the main transmission systems, thus rendering unnecessary the construction of new power stations, leaving the railways to incur expenditure on distribution alone. Speaking of tramways, Mr. Lunn said they were at present under a cloud, owing to the tendency to replace them by petrol omnibuses—a change that was to be deprecated owing to the enormous amount of capital sunk in these undertakings and because petrol was an imported product. He advocated the development of electric trolley omnibus traffic, which, he said, had the advantage of flexibility, comfortable riding, easy control, rapid acceleration and absence of noise, and fumes. He said that it had been estimated that 50 railless vehicles would keep 45 coal miners continually employed, and that the abolition of the electric tramway system in Manchester alone would result in a reduction of coal consumption of 55,000 tons per annum.

BARROW-IN-FURNESS.

Hematite.

There are some who think that the bottom has been reached in the hematite pig iron market, and that from now onwards there will be a gradual improvement.

They base this impression on the fact that a few more inquiries have come to hand, not only from home consumers, but from abroad. There are others who can see no signs of improvement, and who view the heavy stocks which have accumulated with concern. Stocks are certainly high at some works, uncomfortably high, and it will take many orders both from home and from overseas to make any serious impression on them. Even if the iron market did improve, there would still be a considerable overmake at two centres, unless the steel trade should revive, for when the rail and other kindred mills are working their requirements are heavy. It is too early to speak with any certainty about the iron trade. More tangible signs are necessary before one can report an improvement. Iron ore is naturally dull, for both local and outside demands are poor. The same remark applies to foreign ores. There is nothing fresh to report about the steel trade and neither at Barrow nor Workington is there any sign of restarting. Orders are exceedingly scarce at present. The hoop mills are experiencing better trade at present, but American tariffs have by no means benefited the hoop trade from a local point of view. Shipping is dull and shipment of pig iron and steel are down.

SHEFFIELD.

(From our own Correspondent.)

Signs of Improvement.

There is a somewhat more cheerful tendency to be noticed in certain departments of Sheffield trade. Such improvement as can be detected is very slight, and may be only temporary, rather than a definite sign of revival, but it is there, and it is welcome and encouraging. While production in the heavy crude steel branches remains at the low level of recent months, and less than a third of the total number of open-hearth furnaces is in commission, the weight of new business booked during the last week shows some advance. In the better class steels, and also in finished steel products, ground has been both lost and gained, but on the whole the movements have made for progress in the right direction. Generally speaking, the volume of work on hand at present is larger than it was in August. This is nothing to grow enthusiastic over, however, for August was the leanest month experienced in Sheffield for many years. The trade situation still compares very badly with that of October last year. There is no change to report in the condition of the Lincolnshire steel area, where production shows a heavy fall as compared with a year ago.

Progress in Special Steels.

The Master Cutler, in his installation speech a week or two ago, expressed the opinion that Sheffield would continue to be the pioneer of improved qualities of steel. Sheffield's research work in this direction never stops. One branch which is receiving much attention in the laboratories of the great firms at present is that of stainless and corrosion-resisting steels. In their application to industrial purposes these materials have made wonderful strides, and eight or nine different varieties, suitable for distinct uses, are now on the market. The supply of corrosion-resisting steels is not a monopoly of Sheffield, as they are made in several other northern districts, but Sheffield still enjoys the bulk of the trade, and her products hold the field for quality and reliability. Another direction in which progress continues to be made is the production of special alloy steels, such as are required in the most up-to-date engineering practice. Here, again, there is an increased number of makes. In some classes of alloy steels Sheffield has to meet severe competition from home as well as abroad. The best customer for these steels is the automobile trade, which also takes a large quantity of forgings and stampings, and this branch is enjoying a fair trade at present. There has been a falling off of late in the demand from general engineering and also from the shipyards. The old-time carbon crucible cast steels have been much affected by the growth in the use of special steels, and the output of the crucible furnaces has been very low during the past year or two. This steel is, however, not likely to be eliminated from industry, as it is still indispensable for many purposes.

Large Railway Orders.

The policy of economy which is being practised by the railway companies both at home and abroad is responsible for a shortage of work in the shops devoted to the production of axles, tires, and springs. Plants have been so increased, and methods of speeding up production have also made such advances, that Sheffield's capacity can do with a great deal more work than is coming forward at present. The manufacture of buffers, however, is in a healthier state. One of the principal firms engaged in this line is George Turton, Platts and Co., Ltd., who are patentees of special buffers. At the annual meeting of shareholders last week the chairman announced the recent receipt of orders for thousands of these buffers, which, taken together, made up the largest contract for complete buffers ever placed with a Sheffield firm. Their manufacture would call for the use of 2000 tons of steel. The firm's machine shops and buffer forge are now going on night and day work, and it is expected that for the next six months the firm will be exceedingly busy. It hopes during that period to excel its record week's output, which stands at something over 1200 buffers. The firm also manufactures large numbers of coiled springs, stampings and forgings for all kinds of motor vehicles, and other products, and the chairman was able to make the satisfactory announcement that all their six departments showed a profit last year. The firm is especially well employed in connection with the motor trade. The railway steel departments of Sheffield are also interested in the news that the Bengal and North-Western Railway has invited tenders for thirty bogie carriages, and that the India Store Department is in the market for 260 tons of steel billets and hot-water wash-out plant for locomotives.

A Huge Weighing Machine.

In order to deal with the ever-increasing need of accurately ascertaining the weight of their huge steel products, both in the raw and finished state, John Brown and Co., Ltd., are installing at their Atlas Works, Sheffield, a weighbridge which is to be capable of weighing live loads up to 200 tons. It is described as a wonderful weighbridge, in the sense of its great weighing capacity and general design. It has been built by Charles Ross, Ltd., weighing machine makers, Sheffield.

Good Trade in Refractories.

The refractories department of General Refractories, Ltd., of Sheffield and elsewhere, has received an export order of a value approaching £4000. The company is doing well. Its sales during the month of September were well in advance of those of September, 1929, while the total for the first nine months of this year was in excess of the corresponding period of 1929, which in itself was a record year. The company announces that recently it has begun the manufacture of a unique brick, the function of which is the insulation of heating surfaces, which results in a remarkable saving in fuel.

Cutlery and Plate.

In the cutlery and plate trades the ordinary home business, done through shop-keeping channels, continues very poor, and the special trade which usually springs up about this time, in anticipation of the Christmas season, is so far on a small scale. The turnover of firms which depend mainly on this branch of the trade shows a shrinkage as compared with last year, and that year also registered a falling off. The requirements of the caterers are increasing, and are responsible for the placing of many contracts for large quantities of goods of the best class. For these orders there is keen competition. There is an enormous output of goods for the cheap bazaars, and also for distribution by means of coupons. It is significant that the Imperial Tobacco Company of Great Britain and Ireland has joined in the opposition, which is expressed by many shopkeepers, to the practice of distributing articles of cutlery and plate in connection with the sale of cigarettes. The production of goods for such distribution is now a large trade in Sheffield. Exports of cutlery and plate to Australia and India are considerably down as compared with last year, but trade with New Zealand and Canada is well maintained. A certain amount of cutlery of medium and best qualities is sent to several continental countries, as well as to the United States of America, but the trade is not of large proportions.

Sheffield and South America.

Sheffield is hoping to gain a considerable increase of its trade with South America as a result of the trade mission which is now visiting that continent, headed by Mr. A. K. Wilson, the ex-Master Cutler. The mission has already visited Brazil, Uruguay and Argentina, and is at present in Chile. In an interview at Santiago de Chile, Mr. Wilson expressed surprise at the manner in which the South American market has been neglected, chiefly owing to ignorance of conditions. Although Sheffield had a dominant position in the sale of shovels and certain tools, it was, he said, woefully behind in other directions, especially cutlery. As a matter of fact, Sheffield could supply better goods at lower prices than were being sold by other manufacturers. At present the market was mainly shared between the Germans and the Americans. He added that the mission had been everywhere received with sympathy, help, and encouragement. It was impossible to state any definite direction in which the sales of Sheffield products could be increased, as the field was too enormous. The mission was not taking any orders, and was devoting special attention to collecting samples of other nations' goods. It felt confident that big orders would follow presently.

Lincolnshire Water Schemes.

Engineers' reports submitted to the Holland (Lincs.) Regional Water Committee on the scheme for pooling the water resources of the county for the general benefit, and for serving the interests of remote areas, suggest the laying of 190 miles of mains, at an estimated cost of £350,000. The acquisition of existing water undertakings at Boston and Spalding is also included in the programme. Conferences are to take place between representatives of the two County Councils and the Boston and Spalding Councils, with regard to the financial aspects of the scheme, and also a suggested alternative scheme of supply from Dowsby Fen. The Mablethorpe and Sutton Council has already formulated a scheme for the supply of water to the Mablethorpe and Trusthorpe wards from the Council's bore at Maltby-le-Marsh, but it has been decided now to look into the question of obtaining a supply from Sutton-on-Sea. This alternative proposal has arisen from recent successful boring by the Sutton-on-Sea Water Company, from the bore of which, it is claimed, upwards of 30,000 gallons per hour can be obtained.

Sewage Schemes.

A sewage scheme to cost £39,000 is proposed by Chesterfield Corporation, which is desirous of extending and improving its sewage works at New Whittington, in the hope of remedying the present nuisance caused by smell. East Retford Rural District Council has in view a scheme for sewering the village of Ranskill, at a cost of £1751. In both cases applications for borrowing powers have been inquired into by the Ministry of Health.

NORTH OF ENGLAND.

(From our own Correspondent.)

Coal Miners Refuse "Spreadover."

A serious situation has arisen in the Northumberland coalfield as the result of a deadlock between the coalowners and the miners' representatives on the question of working hours under the new Coal Mines Act, which becomes operative on December 1st. The owners have submitted proposals that the 8-hours' shift should continue for all classes with the exception of 12-day men, whose shifts should be reduced by 10 minutes to 7 hours and 50 minutes a day, with two 6-hour shifts—bank to bank—on Sundays, which would keep them within the 90-hours fortnight stipulated by the Act. The miners' representatives contend that the men are averse from adopting the "spreadover" system and favour the application of the flat rate of 7½ hours, as provided by the Act. A strong hint has been made by the owners that the consequences of a refusal to accept the "spreadover" will be an application for a reduction in wages. Until the hours question is out of the way coal prices will be difficult to decide. If there is no "spreadover" of the shorter working hours costs will go up, it is contended, and this, of course, bears directly on prices. Any advance in coal prices would place coalowners in a very difficult position. Foreign competition is already exceptionally keen and prices much lower. A local colliery quoted for a considerable Scandinavian order a few days ago, but Polish coal was taken at 2s. 2d. per ton less than the Northumberland price.

Cleveland Iron Trade.

The Cleveland pig iron trade shows a little more activity than of late, and a particularly notable fact is that the October shipments exceed those for any month this year. This is all the more remarkable in view of the world depression and the desperately keen competition of continental producers, who are underselling British makers in the home market. Clearly, the vitality of the Cleveland iron trade is greater than was imagined. Stocks are being slightly drawn upon to meet current requirements, but conditions do not warrant movement in the direction of increase of the present limited output. Makers have little Cleveland iron stored. Prices are steadily maintained, No. 1 Cleveland foundry iron being 66s., No. 3 G.M.B. 63s. 6d., No. 4 foundry 62s. 6d., and No. 4 forge 62s.

Hematite Pig Iron.

In the East Coast hematite pig iron trade a steady, though far from extensive, business is passing. Sales include small parcels for overseas customers, in spite of comparative cheapness of continental iron. Sheffield firms are placing a few orders in this district, and local consumption is on a slightly improved scale. Merchants still hold considerable quantities, but are not now underselling makers. Ordinary qualities of East Coast iron are quoted at 71s., and No. 1 quality is at a premium of 6d. per ton.

Ironmaking Materials.

Next to nothing is being done in the foreign ore trade. Consumers have considerable quantities on hand and have large contracts arranged at substantially above rates at which purchases can now be made. Best Rubio is put at 17s. c.i.f. Tees. Sellers of blast-furnace coke experience difficulty in persuading ironmasters to negotiate for supplies, and quotations are barely maintained. For early delivery of good average qualities to works in this district the recognised market rate keeps at 17s.

Manufactured Iron and Steel.

While the position in the manufactured iron and steel trade is a little better than of late, and inquiries show some expansion, there seems little prospect of any extensive buying. The total volume of trade passing is still on a disappointing scale, but now that prices are to remain unchanged over the next three months at least, producers hope that orders may be released that had been held back in anticipation of a reduction in quotations. An order for the manufacture of 2000 tons of steel pipes has been booked this week by the South Durham Steel and Iron Company, Ltd., from the Liverpool Water Board. The pipes will be used in North Wales. The contract will be carried out at the firm's pipe works at Stockton.

Steamer Order for the Wear.

An order for a cargo steamer, the first placed on the Wear for some months, has been booked by W. Pickersgill and Sons, Ltd., Southwick. The vessel, which will be of 4550 tons deadweight, is for a Sunderland shipowning firm. As the vessel's propelling machinery is to be constructed at Southwick, Sunderland, by George Clark, Ltd., the news of the order, which will take about four months to complete, is very welcome to the district. Several of the Wear shipyards are idle at present, and Messrs. Pickersgill only a fortnight ago launched the last of their ships on order.

The Coal Trade.

There is little or no change to record in the Northern coal market situation. The altered marketing schemes have not had time to have any effect. Operators fear that most of their overseas customers will have covered their requirements for the next two months, and beyond hoping consumers will take out their full contract commitments, they have little prospect of activity setting in. This is the busiest season for stocking coal in Northern regions, but orders are below the average. In some parts of Europe there is an opinion that the winter is going to be a mild one. It is, however, far too early to speculate as to what the weather is going to be. The really severe days rarely come until January. Supplies in Poland exceed the demand, and the latest reports go to show that fairly long credits are being given in order to book output in advance. This is worth remembering when so little is being done forward in this area owing to the uncertainty as to what the range of minimum prices will be. It may be a few weeks before they are ready. Prompt business, however, is keeping up very well in the Northumberland steam coal trade. There is a stronger feeling in values, and best Northumberlands command 13s. 6d. Seconds are offered at 12s., but steam smalls are plentiful at the old prices. During the past few days a steadily improving position has been noticeable for all best or special gas coal qualities. The output of these grades has been steadily reduced, and now production is barely up to requirements. Prompt buyers are offering the enhanced price of 15s. 6d. for early delivery, and from 15s. 3d. to 15s. 6d. for over

the remainder of the year. Secondary gas coals remain in excessive supply, and 12s. 6d. is the best offered by merchants. Durham coking unscreened are plentiful and there is a little more business passing, though insufficient to harden prices, which remain at 12s. 6d. to 13s. The bunker trade is disappointing, and there are abundant supplies of good ordinary classes at 12s. 6d. and of superiors at about 13s. 6d. The makers of blast-furnace coke are now finding it far from easy to obtain 17s., but they are not making any concessions yet. Foundry coke for shipment is lacking in support at the moment, but beehive coke is steady, and gas descriptions firm, with output well cleared over the next two or three weeks. All coke prices remain unaltered.

SCOTLAND.

(From our own Correspondent.)

Continued Depression.

THE situation, so far as regards steel, iron and coal, has not undergone any change. It has been said that in all probability the existing depression has not reached the rock-bottom stage, and unfortunately there seems to be a strong possibility that the effects may continue to be felt to an even worse degree than at present. Already the scarcity of orders for shipbuilding materials is being deplored, and if rumours are true and more Clyde yards close down until more prosperous times are assured, the outlook for certain industries must be relatively less encouraging. Rationalisation schemes may accomplish their object in time, but the ill effects of the depression remain, and they may be amplified before the industries affected adjust themselves to meet the conditions following reorganisation. Present indications promise nothing in the way of advancement over the winter months, the outlook in the industries already mentioned being poor in the extreme.

Steel.

On home markets there is a dearth of orders, and even those consumers who buy regularly are unable to absorb their usual quantities. Export on the whole is negligible. Heavy steel is poorly specified, and a considerable amount of idleness is reported. Sheet makers have a fair amount of business in light black sheets, but they are feeling the effects of the slump in galvanised descriptions. Usual lines of galvanised sheets normally providing a considerable volume of business are comparatively idle at present. The improvement noted in tubes a week or two ago has not been maintained, and some of the works, especially those interested in small-diameter sections, are idle. On the whole, the volume of business is depressingly low and broken time is the rule. It may be said, however, that the impression is gaining that prices of materials, particularly in continental markets, have reached their lowest, and that there is a likelihood of some improvement in business when that impression becomes more general.

Iron.

Business in the iron market still languishes. Re-rolled steel bars are perhaps a shade steadier with prices at £7 7s. 6d. home and £7 5s. per ton export, but bar iron remains almost neglected. Only some ten pig iron furnaces are in operation in Scotland, but the demand is such that outputs are more than sufficient along with the considerable quantities that continue to reach this district from India and the Continent. Last week 5400 tons of pig iron from Calcutta were unloaded at Glasgow Harbour, along with 600 tons from Millom.

Coal.

The coal market derives no encouragement from either the home or the export demand. The former suffers from local industrial depression and continued mild weather, and the latter largely from the foreign competition in continental markets. Foreign orders are small and mostly for prompt delivery, exporters being unable to entertain anything in the way of forward deliveries, owing to the possible effect on prices of future action as the outcome of the Coal Mines Act and colliery schemes. Meanwhile, all fuels remain plentiful, with the exception of washed treble nuts. Prices are a matter of arrangement. Aggregate shipments amounted to 206,111 tons against 242,360 tons in the preceding week and 293,351 tons in the same week last year. The scheme for the regulation of production, supply and sale of coal in Scotland has been amended by the committee, and it is expected that in its present form it should meet with the approval of the Board of Trade. It will now be submitted to the Association for acceptance or rejection.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Shipments and Contracts.

IT was somewhat of a shock to find that last week, according to the returns of the G.W.R. Company, shipments of coal at the principal ports in South Wales came to only 430,000 tons, which was a reduction of 140,200 tons as compared with the preceding week, and no less than 162,400 tons below the figure for the corresponding period of last year. It was realised that the total must inevitably be reduced to some extent, as, during the second half of the week the number of idle tipping appliances varied daily from 30 to 44, which shows that tonnage was not at the disposal of collieries. Nevertheless, it was scarcely expected that the quantity for the week would constitute the lowest for any normal week this year. As the result of arrivals over the week-end, the situation on Monday was that the number of idle tips was reduced to 25, while there were seven steamers waiting to berth, of which five were lying at Swansea. The fact is that in the Swansea area shipment activity is satisfactory, as the outlet for anthracite coals is so much better than for steam qualities. The demand for the latter is distinctly quiet, and as the volume of chartering remains about 250,000 tons per week, there is not much hope for an expansion in the quantity of coals for export during the next week or two. Reports are current of business being done over next year for French railways, and the quantity is estimated at round about three-quarters of a million tons, the buyers being the State Railways and the P.L.M. Railways. No confirmation of these purchases is forthcoming, and, in fact, is rarely obtainable. At the same time inquiries show that the total is more likely to be half a million tons, which is below the quantity bought for delivery during the current year, as purchases have been made of North Country coals. The Royal Swedish Administration has asked for tenders for 12,000 tons of best Admiralty large coals for shipment during the last two months of this year, and there are inquiries in other directions for a few cargoes for delivery round about the end of the year, but otherwise there is not much in the position to call for comment.

Regulation Scheme and Wage Negotiations.

Intimation was received in the early part of this week that the South Wales District (Coal Mines) Scheme, 1930, had been approved and signed by the Secretary of Mines and came into operation as from Tuesday last. The official details of the scheme have not yet been published. The main outline of them, however, has been given, and, as is well known, it involves the regulation of output and the fixing of minimum prices, and all coalowners come within the scheme, whereas formerly under the voluntary scheme which was in operation, there was a number of colliery undertakings which were outside it. Now that all coalowners are affected by the scheme, it does not follow that, so far as export business is concerned, there will be any immediate improvement in trade or prices. In fact, it would be unwise to calculate upon such improvement. Prices cannot immediately be put on a higher basis in face of existing competition for business. With regard to the new wages agreement, there was a further meeting of the joint committee of coalowners' and miners' representatives at Cardiff on Tuesday; but though various aspects of the situation were discussed, nothing final was arrived at and further meetings will be necessary.

G.W.R. Company and Rebates.

Official notice has been given by the Great Western Railway Company of its intentions regarding the continuance or alteration of rebates on local dock rates and charges which were made originally on October 1st, 1929, under the Local Government (Derating) Act. As from October, 1930, the relief on coal, coke and patent fuel of ¾d. per ton will be increased to 1d. per ton shipped from fully loaded 20-ton wagons. The rebate on imported iron ore will be increased from 1½d. per ton to 4d. per ton, while that on specified classes of iron and steel, including tin-plates, shipped to foreign countries, will be advanced from 4d. to 9d. per ton. The existing uniform rebate of 7½ per cent. of the wharfage rates on all merchandise, excluding oil, not specified in the official notice, shipped at the ports, has been altered to a rebate of 3d. per ton on shipments, otherwise than coastwise, a reduction of 7½ per cent. continuing to apply to coastwise shipments. A rebate is also to be allowed as from October 1st last of 2d. per net register ton in the tonnage rates on vessels going to foreign ports and calling at South Wales ports for bunker coals only, and 1d. per ton in the cranage charge for quayside cranes loading and discharging general traffic. The official notice points out that the scale is based on an estimate of the rate-relief accruing to the company and of the volume of traffic to receive rebates commensurate to such rate relief. As the company will only allow rebates corresponding to the relief actually received by it, it naturally reserves the right to make adjustments.

Steelworkers' Wages.

As the result of the sliding scale ascertainment for the three months ended September 30th last, the wages of West Wales steelworkers for the next three months will be reduced 2½ per cent. The ascertainment shows that the average price of Siemens steel bars was a shade over £5 18s. 8d. per ton f.o.t., makers' works, which is equivalent to 8¾ per cent. under the sliding scale agreement, as compared with 11¼ per cent. for the preceding quarter. The reduction in wages will operate as from November 2nd up to, and including, January 31st, 1931. The question of the continuance of certain *ex-gratia* payments to the lower-paid workmen will be discussed later between the employers and the workmen's organisations.

General Cargo Trade.

Efforts are being made to extend the general cargo trade at Cardiff, and the question is being examined as to the prospects of Cardiff being made a deep-sea fishing centre. The docks are thoroughly well equipped to deal with trade of all descriptions, and in connection with the expansion of the general cargo trade it is interesting to note that the managers of the Reardon-Smith Line, the headquarters of which are at Cardiff, have decided to extend their regular general cargo service from the North American Pacific Coast ports to the United Kingdom, so as to include Cardiff in their ports of call. A call is also to be made at Avonmouth, and if there is sufficient inducement offered, Newport and Barry will be included in the itinerary. The service to Cardiff will be inaugurated by the s.s. "Indian City," which will arrive about the middle of December.

Current Business.

Steam coals continue to be quiet in demand, except sized qualities, which remain firm; but otherwise the large coal market and that for smalls is depressed. Supplies of the latter are plentiful, and many collieries are, as a consequence, working very irregularly. Coke and patent fuel inquiries for early shipment are also slow and pitwood displays no improvement.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

LEWENE AND WILKINSON, Ltd., ask us to announce that they have changed the address of their office from No. 25 to No. 74, Victoria-street, Westminster, S.W. 1, and that their telephone numbers are now Victoria 1753 and 1754.

THE DEPARTMENT OF OVERSEAS TRADE asks us to announce that Mr. H. A. N. Bluett, the British Commercial Agent at Batavia, will be available at the offices of the Department from November 3rd to 21st for the purpose of interviewing firms interested in the export of British goods to the Netherlands East Indies. Firms desiring interviews with Mr. Bluett in London should apply to the Comptroller-General, Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1, quoting the reference 481/1/30.

CONTRACTS.

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., has recently received orders for eight Ward-Leonard equipments, four for Australia and four for Rhodesia, which involve together nearly £120,000 worth of electrical plant.

THE CLEAN COAL COMPANY, Ltd., has received an order from Newton, Chambers and Co., Ltd., of Sheffield, for a complete coal-cleaning plant operating under the C.C. patented system. This plant is to supply clean coal to the battery of modern coke ovens recently erected by Thorncliffe Coal Distillation, Ltd., at Smithy Wood, South Yorkshire.

THE GREAT WESTERN RAILWAY COMPANY has officially announced that the following orders, in order of value, have been placed:—Alterations to engine shed, new lifting shop and other works at Reading, H. D. Bowyer, Slough; construction of a twin-screw tug boat for Cardiff docks, Chas. Hill and Sons, Ltd., Bristol; supply and erection of one fixed coal hoist at west side of East Bute Dock, Cardiff, Head, Wrightson and Co., Ltd., Thornaby-on-Tees; new goods shed at Park Royal, Wm. Walkerdine, Ltd., London; supply and erection of one 3-ton portal level-luffing electric crane for Glasgow Wharf, Plymouth, Sir Wm. Arrol and Co., Ltd., Glasgow; repairs to the dredger "David Davies," Port Talbot Graving Dock and Shipbuilding Company, Ltd.; additional accommodation at goods shed at Market Drayton, Wm. Willitts and Son, Ltd., Kingswinford; two 16ft. tipping turntables for 20-ton wagons for Queen Alexander Dock, Cardiff, the Horsehay Company, Ltd., Horsehay; repairs for the overhaul of the tug "Lord Glanely," Harris Brothers, Ltd., Swansea; supply and erection of one 2-ton electric lift, inwards goods shed, Hockley, Wm. Wadsworth and Sons, Ltd., Bolton; and electrification of 6-ton fixed hand brake, New Mileage Yard, Paddington, the Wharton Crane and Hoist Company, Ltd., Reddish, near Stockport.

LAUNCHES AND TRIAL TRIPS.

POLARTANK, motor tanker; built by Barclay, Curle and Co., Ltd., to the order of Messrs. Melsom and Melsom, Norway; dimensions, 420ft. by 58ft. 6in. by 32ft. 3in.; to carry oil in bulk. Engines, oil engines, Barclay-Curle-Doxford type; constructed by the builders; launch, October 6th.

ATTILA, single-screw oil tank motor ship; built by Sir W. G. Armstrong-Whitworth and Co. (Shipbuilders), Ltd., to the order of Mr. Alf. Jakhelln, Oslo; dimensions, 460ft. by 59ft. 7in. by 33ft. 7in.; to carry 11,000 tons oil in bulk. Engines, oil engines; constructed by the builders; launch, October 7th.

SVEVE, tanker; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of A/S.D./S. Atlantic, of Bergen, Norway; dimensions, 435ft. by 57ft. 6in.; to carry oil in bulk. Engines, oil engines; constructed by the builders; launch, October 7th.

SWIFT, single-screw steamer; built by Workman, Clark (1928), Ltd., to the order of the General Steam Navigation Company, Ltd.; dimensions, 225ft. by 35ft. by 21ft. 6in.; to carry cargo. Engines, triple-expansion; constructed by the builders; launch, October 7th.

CALDER, single-screw steamship; built by Cammell Laird and Co., Ltd., to the order of London, Midland and Scottish Railway Company; dimensions, 240ft. by 34ft. by 16ft. 4in.; to carry cargo and horses. Engines, triple-expansion, 22in., 36in. and 61in. by 39in. stroke, pressure 200 lb. per square inch; constructed by the builders; launch, October 8th.

SOMALI, single-screw cargo vessel; built by Harland and Wolff, Ltd., to the order of Hain Steamship Company, Ltd.; dimensions, 458ft. by 60ft. 6in. by 40ft. 9in.; to carry cargo. Engines, quadruple-expansion, pressure 230 lb. per square inch; constructed by J. G. Kincaid and Co., Ltd.; launch, October 9th.

WILLIAM STRACHAN, motor-driven oil tanker; built by Workman Clark (1928), Ltd., to the order of Messrs. Oppen and Sarensens Tankrederi A/S, Oslo, Norway; dimensions, 422ft. by 55ft. 3in. by 33ft. 6in.; to carry oil in bulk. Engines, oil engines; constructed by the builders; launch, October 9th.

MABAHISS, research steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Coastguards and Fisheries Service, Egyptian Government; dimensions, 148ft. by 23½ft.; for research work. Engines, triple-expansion, constructed by the builders; trial trip, recently.

MORGENEN, oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of A/S. Tanktransport, of Tonsberg, Norway; dimensions, 456ft. by 58ft. 9in.; to carry petroleum in bulk. Engines, Neptune Atlas Polar oil engines; constructed by the builders; trial trip, recently.

MOTOR LAUNCH; built by James Pollock, Sons and Co., Ltd., to the order of British owners for service abroad; dimensions, 55ft. by 13ft. by 3ft. 3in. Engines, 30/38 four-cylinder type "4 D.P. Atlantic" engine; constructed by the builders; trial trip, recently.

NORE, oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Rasmussen og Moes Rederi A/S., of Sandefjord, Norway; dimensions, 474ft. by 59½ft.; to carry 11,300 tons. Engines, oil engines, Wallsend-Sulzer type; constructed by the Wallsend Slipway and Engineering Company; trial trip, recently.

RECENT DRAG-LINE EXCAVATOR PRACTICE IN GERMANY.—In connection with an illustrated article under the above heading, which appeared in our issue of October 10th, we are asked by Adolf Bleichert and Co. to state that all the drag-line excavators described by Dr. Bruchman were built by them.

INSTITUTION OF NAVAL ARCHITECTS.—The Council of the Institution of Naval Architects has awarded the "Yarrow" Scholarship in Marine Engineering (1930) to Mr. W. J. Reynolds, of Messrs. Alexander Hall and Co., Aberdeen. The scholarship is of the value of £100 per annum, and will be held at Glasgow University for four years.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	17/9 to 20/6
(1) Spanish	20/6 to 21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	16/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 17 0	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 6 0	3 6 0
Siliceous Iron	3 6 0	3 6 0
No. 3 G.M.B.	3 3 6	3 3 6
No. 4 Foundry	3 2 6	3 2 6
No. 4 Forge	3 2 0	3 2 0
Mottled	3 1 6	3 1 6
White	3 1 6	3 1 6
Midlands—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	— *	—
,, ,, Foundry	— *	—
(c) Northampton—		
Foundry No. 3	— *	—
Forge	— *	—
Derbyshire—		
No. 3 Foundry	— *	—
Forge	— *	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (a) / 4 5 6 (b) / 4 10 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
,, ,, (Land)	10 0 0	10 0 0
Ship Plates, ¼in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 15 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	11 15 0	11 12 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
,, ,, (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 7 6	—
,, (Small Round)	7 12 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	9 10 0	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	10 5 0	—
Soft Wire Rods	8 0 0	—
Midlands—		
Small Rolled Bars	7 12 6 to 8 10 0	—
Billets and Sheet Bars	5 15 0 to 6 5 0	—
Galv. Sheets, f.o.b. L'pool	11 12 6	—
(2) Staffordshire Hoops	10 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	17/–
Block Tin (Cash)	118 17 6
,, (three months)	120 5 0
Copper (cash)	41 18 9
,, (three months)	41 17 6
Spanish Lead (cash)	15 7 6
,, ,, (three months)	15 6 3
Spelter (cash)	14 3 9
,, (three months)	14 18 9
Manchester—	
Copper, Best Selected Ingots	46 15 0
,, Electrolytic	47 10 0
,, Strong Sheets	73 0 0
,, Tubes (Basis Price), lb.	0 0 11
Brass Tubes (Basis Price), lb.	0 0 10
,, Condenser, lb.	0 1 0
Lead English	17 7 6
,, Foreign	16 0 0
Spelter	15 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 5 6	7/–
,, ,, 6 p.c. to 8 p.c.	£22 10 0	7/–
,, ,, 8 p.c. to 10 p.c.	£22 0 0	7/–
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	10/–
,, ,, ,, 1 p.c. carbon	£38 0 0	12/–
,, ,, ,, 0·70 p.c. carbon	£41 0 0	14/–
,, ,, ,, carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
,, ,, ,,	£11 5 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/– per unit	
,, ,, 75 p.c.	£18 0 0 scale 7/– per unit	
,, Vanadium	12/9 per lb.	
,, Molybdenum	4/2 per lb.	
,, Titanium (carbon free)	11d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/6
,, ,, Ell	13/6
,, ,, Splint	14/– to 15/3
,, ,, Trebles	12/6
,, ,, Doubles	12/–
,, ,, Singles	10/6
Ayrshire—	
(f.o.b. Ports)—Steam	13/–
,, ,, Jewel	16/–
,, ,, Trebles	13/–
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	10/6 to 11/6
Screened Navigation	16/6 to 17/6
Trebles	13/6 to 15/–
Doubles	12/6
Singles	10/6
Lothians—	
(f.o.b. Leith)—Best Steam	11/–
Secondary Steam	10/9
Trebles	13/3
Doubles	12/3
Singles	10/6

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		20/6 to 21/–
Household		32/6 to 53/6
Coke		21/– to 22/–
Northumberland—		
Best Steams		13/4½
Second Steams		12/–
Steam Smalls		10/– to 10/6
Unscreened		12/6
Household		25/– to 37/–
Durham—		
Best Gas		14/9 to 15/–
Second		12/9 to 13/–
Household		25/– to 37/–
Foundry Coke		24/– to 26/–
Sheffield—		
Best Hand-picked Branch	25/6 to 27/–	—
Derbyshire Best Bright House	20/– to 22/6	—
Best House Coal	19/6 to 20/6	—
Screened House Coal	17/6 to 19/–	—
,, ,, Nuts	14/6 to 16/6	—
Yorkshire Hards	14/– to 15/6	—
Derbyshire Hards	14/– to 15/6	—
Rough Slacks	8/6 to 9/–	—
Nutty Slacks	6/6 to 7/6	—
Smalls	3/– to 5/–	—
Blast-furnace Coke (Inland)	12/6 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b. 17/– to 18/6		

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	20/–
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/6 to 17/7½
Best Steam Smalls	13/3 to 13/6
Ordinary Smalls	11/6 to 12/9
Washed Nuts	17/6 to 22/–
No. 3 Rhondda Large	20/– to 20/6
,, ,, Smalls	15/6 to 16/–
No. 2 ,, Large	17/– to 17/3
,, ,, Through	16/– to 16/6
,, ,, Smalls	14/– to 14/3
Foundry Coke (Export)	27/6 to 35/–
Furnace Coke (Export)	17/6 to 20/–
Patent Fuel	21/6
Pitwood (ex ship)	24/9 to 25/–
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/– to 37/6
Seconds	27/– to 31/6
Red Vein	23/6 to 27/–
Machine-made Cobbles	41/6 to 45/–
Nuts	40/– to 46/–
Beans	24/6 to 27/6
Peas	21/– to 21/6
Breaker Duff	9/9 to 10/3
Rubbly Culm	9/6 to 10/–
Steam Coals:	
Large	19/6 to 21/6
Seconds	18/– to 19/6
Smalls	12/– to 13/–
Cargo Through	15/6 to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

(d) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers.

(e) Delivered Black Country Stations. * Under revision at the time of going to press.

French Engineering Notes.

(From our Correspondent in Paris.)

The Steel Cartel.

THE meeting which was held in Paris last week to settle the differences between the French and other continental steel producers had to be postponed through the failure of the Belgian and German members of the Cartel to give an undertaking to limit their consignments of steel to this country. As another meeting is to be held shortly there is some hope of the difficulty being smoothed over, in which event the representatives of the Cartel will assemble in Brussels immediately afterwards to discuss the conditions under which that body can be reconstructed at the end of the year. The outlook is by no means reassuring, particularly in view of a certain feeling of hostility in Belgium towards the Cartel and of the uncompromising attitude of German steel makers, who declare that the Cartel cannot be effective unless it is based upon the maintenance of a minimum scale of prices for foreign trade. As all the members have not yet signed the agreement to prolong the Cartel until the end of the year, it has practically ceased to operate. The next few days should decide whether or not the organisation will be revived. Meanwhile steel prices have continued to decline, and are now generally regarded as having reached rock bottom level.

Railway Deficits.

The railway companies are expected to show on the past year's working a total deficit of something like 1600 million francs. The situation is so serious that the Government has taken the matter in hand and is endeavouring to find a remedy. The most obvious thing to do is to raise still further the railway rates, but that step is strongly opposed by users, who declare that any additional burdens, just now, would be disastrous for industry. It is true that the companies propose, as an alternative, the suppression of the taxes on traffic receipts, which are stated to be higher than in any other country, but the Government makes no reference to an abandonment of that source of State revenue in the suggestions it is putting forward with a view to alleviate the situation. For the moment, apart from the proposal to increase the railway rates, one of the Government's recommendations is to effect economies in railway management. Another aims at protecting the railways from the competition of road and inland waterway traffic, and that is a matter which promises to be debated when the next Finance Bill comes before Parliament. So far, all forms of traffic have been encouraged as being equally necessary for the national welfare. Now that it is seen that the railways are suffering from such competition, Government finds that its first duty is to protect them from threatened disaster. Therefore a final remedy contemplated by the Government is to impose "compensating taxes" on all traffic that comes into competition with the railways.

Omnibuses and Tramways.

At a time when the public preferences are for a suppression of tramways in Paris as a means of obviating traffic congestion, and also because it is believed that motor omnibuses can deal with the traffic more satisfactorily than the tramways, the Société des Transports en Commun is endeavouring to show that there is much to be said in favour of tramways from the point of view of economical working. As the road transport arrangements in the Department of the Seine are under one management, and as practically the whole of the suburban traffic is dealt with by tramways, the company has every interest in extending them as far as possible in Paris, as is done at present, except for a few lines in the centre which have been suppressed. At the recent congress in Warsaw of the International Union of Road Transports, Monsieur Bacqueyrisse, the technical director of the Société des Transports en Commun, invited members to visit Paris and see what was being done in the way of recuperating energy on the tramways whereby an economy of 25 to 30 per cent. is effected in electrical consumption. About twenty tramcars have been running experimentally for some time with the new recuperating equipment. Last week a large number of members responded to the invitation, including a party from England, who travelled from Boulogne to Paris in the latest type of two-decker omnibus, similar to those in service in Manchester. The vehicle attracted a great deal of interest, but it is hardly likely to influence changes in the Paris motor omnibuses, for the reason that the traffic conditions are entirely different from those in Manchester and London. When the motor omnibus services were started in Paris the upper deck was suppressed on account mainly of the steep gradients that had to be negotiated in some parts of the city. Sharp turns on such gradients necessitated a low centre of gravity. The stoppages are also much more frequent in Paris than in London.

Railway Enterprise.

Primarily as a means of developing traffic, all the railway companies have "agricultural services," which help and encourage industries in territories covered by their respective systems. For years past the Paris-Orleans Company has organised demonstrations of labour-saving machinery in agricultural districts, and one of the most successful was that which took place recently at Montlhéry, when a large number of tractor ploughs and light cultivating machines were shown in operation, and it appeared quite evident, from the quality of the work done and the interest taken in the demonstration, that mechanical ploughing has made a great step in advance. Another instance of such enterprise is afforded at the Gare Saint-Lazare, in Paris, where the State Railways have organised a permanent exhibition which is being devoted, at the moment, to the standardised packing of agricultural produce, while machines for making packages are shown in operation.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

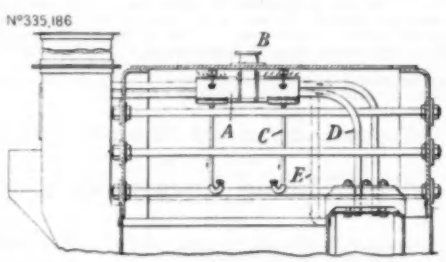
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

335,186. March 16th, 1929.—IMPROVEMENTS IN STEAM DRIERS, Thomas Sugden, 180, Fleet-street, London, E.C. 4.

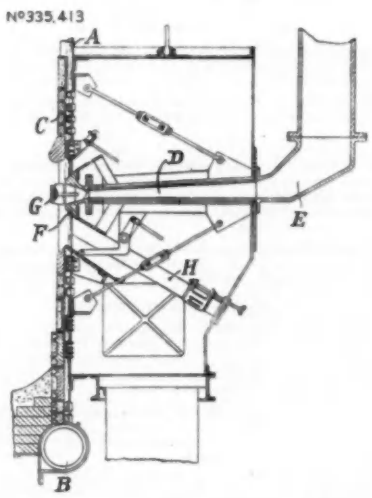
In the steam-collecting space of a boiler a steam separator or anti-priming device A is arranged. The precise construction of this device may be varied. It may consist of a casing into which the steam enters along the top edge and through which the steam flows past baffles to the main steam pipe B. Drops of moisture thrown off by the steam in passing round the baffles fall to the bottom of the casing and are returned to the water space of the boiler through drain pipes C fitted at their ends with check valves. The feature of the invention consists in using a portion of the furnace gases for the completion of the



drying of the steam. To that end one or more tubes D rise from the furnace crown and are led through the separator within which the steam comes into contact with their outer walls. The gases are finally discharged into the smoke box of the boiler, at which point the tubes may be fitted with dampers to regulate the flow of gases through them. The tubes D may be plain or corrugated or fitted with radial ribs and may ascend from the crown of the fire-box or, as shown at E, may to some extent be led through the water space of the boiler in order to cool the furnace gases somewhat before they are passed through the separator. The steam, after passing through the separator, may be either dry or slightly superheated.—*September 16th*, 1930.

335,413. October 24th, 1929.—IMPROVEMENTS IN BURNERS FOR FURNACES, Babcock and Wilcox, Ltd., Farringdon-street, London, E.C. 4 (a communication from the Fuller Lehigh Company, Fullerton, Pennsylvania).

This burner is for firing pulverised fuel. One wall of the furnace is composed of tubes A, which enter a header B outside the furnace and through which cooling fluid circulates. On the furnace side the tubes are lined with blocks C, which present a continuous wall except where they are omitted to permit the passage of the fuel between the tubes into the furnace. The burner D flares in plan to a wide mouth of narrow height, and delivers the fuel through the spaces between a considerable number of the tubes. The mixture of fuel and air is delivered to the burner through an elbow E, which is shaped in such a way as to spread the mixture out laterally and uniformly in the burner. At the exit end the burner is connected to an outlet

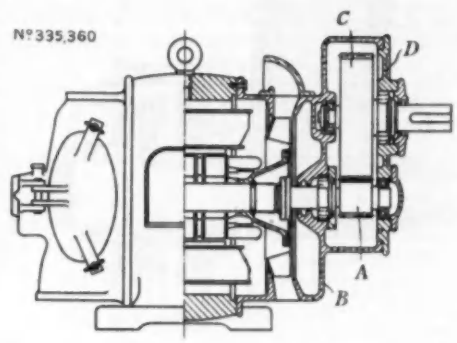


F, which is also attached to the tubes A, and which is formed with divergent upper and lower walls. This outlet, like the burner, extends across several rows of the tubes. Above and below it inclined passages controlled by dampers are provided for the admission of secondary air. On the furnace side of the tubes a row of deflecting blocks G is clamped by U bolts opposite the burner outlet. These blocks are provided with curved surfaces facing the burner outlet, with the result that the mixture of air and fuel leaving the burner is divided into two streams. Each such stream is impinged upon, substantially at right angles, by the secondary air. In this way the fuel and air are intimately mixed, and, it is claimed, practically the entire volume of the furnace can be used effectively for combustion. The burner and dampers are surrounded by a casing to which air under pressure is supplied. At H a port is provided whereby a lighter may be introduced through the casing to the burner outlet.—*September 25th*, 1930.

DYNAMOS AND MOTORS.

335,360. September 13th, 1929.—IMPROVEMENTS IN ELECTRIC MOTORS, Siemens-Schuckertwerke A.G., Berlin-Siemensstadt, Germany.

In back-geared motors used for the direct driving of machine tools, the gearing is often connected to the stator casing in such a way that the motor and the reducing gear form a unit. The first wheel of the reducing gear is mounted directly on the motor shaft, and therefore if a fault occurs in the motor the gearing itself cannot be used again until the fault has been made good. In these circumstances it is essential to carry in stock complete back-geared motors, each with its own reducing gear. It is pointed out in this specification that damage to the motor occurs much more frequently than damage to the gearing. If, therefore, the gearing can be designed to be readily separated from the motor, the reserve stock carried may consist principally of motors without their reducing gears. The invention consists of a back-geared motor in which the gearing is readily



separated from the motor. The pinion A of the back gearing is carried on a ball-bearing shaft, which is flanged for attachment to the motor shaft. This pinion and its shaft are mounted in a casing B, which is bolted to the stator casing. The second wheel C of the reducing gear is mounted within the same casing, the cover D of which contains one bearing of the first and one bearing of the second shaft. The flange coupling between the motor and pinion shafts is of the claw or similar locking type. When the motor is separated from the reducing gear that gear remains as a complete unit, which may immediately have a fresh motor coupled to it.—*September 25th*, 1930.

TELEGRAPHS AND TELEPHONES.

314,092. June 22nd, 1929.—IMPROVEMENTS IN RADIO-TELEPHONIC SYSTEMS, Riccardo Bruni, Via XX Settembre 36/7, Genoa, Italy.

This specification describes a selective wireless telephonic system designed to be free from interference caused by "atmospherics." At the transmitting station—Fig. 1—the signals are impressed on a current of intermediate frequency—say, 20,000 cycles—which modulates the carrier wave. A is the transmitter set, B the microphone circuit, and C the heterodyne generator. The current generated in the coil D by the generator C is superposed on the microphonic current passing through the connections between A and B. At the receiving station the intermediate frequency is selected by a coil and condenser in series, and tuned to the intermediate frequency. Interfering currents are neutralised by a shielded inductance. A second coil tuned to the intermediate frequency by a parallel condenser is coupled to the first coil, and also to a heterodyne oscillator,

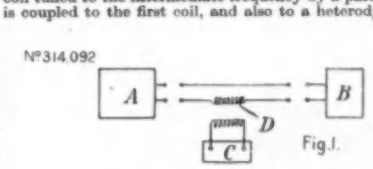


Fig.1.

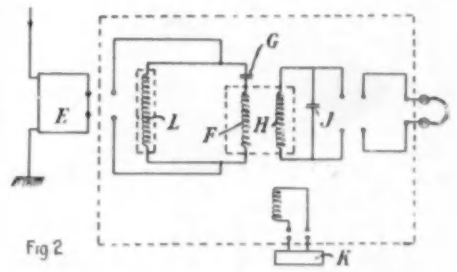


Fig 2

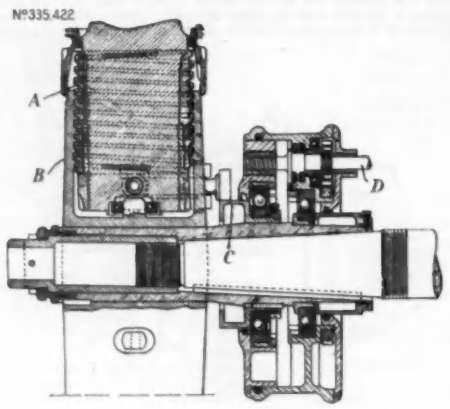
to produce beats which are received in a telephone. The receiver is indicated at E. The coil and condenser tuned in series to the intermediate frequency are shown at F G, and the coil and condenser tuned in parallel to the same frequency are represented at H J. The two coils are shielded. The heterodyne oscillator coupled to the coil H is shown at K. It is provided with an inductance. Interfering currents are neutralised by a shielded inductance L. The theory on which the receiving apparatus separates the desired signals from parasitic currents is that while the wave carrying the intermediate current, on which the signal is impressed, is detected, a low-frequency current is detected in the case of the parasitic current. The local heterodyne produces an oscillating current, which interferes with the intermediate current used at the transmitting station. As a consequence, beats are produced which introduce a current into the coupled coil. It is not, however, possible to produce beats with the low-frequency parasitic currents which are detected.—*September 22nd*, 1930.

AERONAUTICS.

335,422. October 30th, 1929.—IMPROVEMENTS IN VARIABLE PITCH METALLIC SCREW PROPELLERS, P. J. P. Ratier, 97, Route de Châtillon, Montrouge, France.

This invention is stated to be based on the new discovery that the twisting couple which tends to bring the blades of a variable pitch propeller back to the position of minimum pitch is produced almost entirely by centrifugal force, the aerodynamical reaction contributing almost negligibly to it. Each blade is mounted and held within a foot-piece A on the exterior of which is cut a low-pitched thread. This thread engages with considerable clearance with a similar thread formed inside the hub B. Balls are run into the clearance space between the two threads, spring stops being provided at the two ends of the string of balls to retain them in position. This arrangement constitutes a helicoidal ball bearing between the blade foot and the hub. The pitch and direction of the thread are so chosen that the twisting couple produced by the centrifugal force on the blade and acting to set it into the position of minimum pitch is just balanced by the effect of the same force acting through the helical ball bearing and tending to turn the blade in the opposite

direction. The control of the blade is therefore claimed to be rendered very easy. That control is exercised through the agency of a sliding sleeve C, which is linked to a short arm projecting from the root of the blade. The details shown on the right of the engraving illustrate one method of affecting the sliding of the sleeve. They comprise a system of three screws geared together, and operated in unison by the pilot through the agency of a

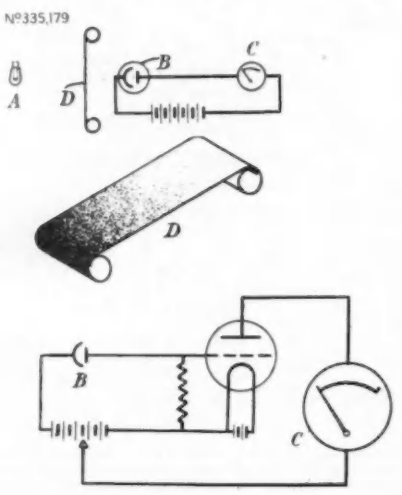


single shaft D. When the sleeve C is moved axially the two blades of the propeller twist in opposite directions. This twisting movement, while it effects the main purpose of altering the pitch, also results, by virtue of the existence of the threaded roots, in an axial displacement of the blades. This axial movement is, however, slight because of the low pitch of the threaded roots.—*September 25th*, 1930.

MEASURING AND TESTING INSTRUMENTS.

335,179. June 17th, 1929.—Improvements in Means of Measuring Intensity of Light, F. W. Gillard, 7, York-road, Erdington, Birmingham.

This photometer is of that class in which the intensity of a source of light is measured by means of a selenium or other form of photo-electric cell working in conjunction with a current indicating instrument. In photometers of this general type difficulty is encountered in dealing with the relatively weak currents furnished by the photo-electric cell. They can, it is stated, be employed only for roughly measuring light intensities of high values. The photometer described is claimed to be suitable for measuring any, and particularly low, intensities. In the first diagram A is the source of light the intensity of which is to be measured. B is the photo-electric cell and C the current-indicating instrument. The scale of this instrument C may be marked 0 at zero deflection, 1 at half-scale and 2 at full-scale deflection. Its readings are not employed as a direct means of measuring the light intensity. Between the source of light A and the cell B there is placed a graduated light filter consisting of a graduated slot, an iris diaphragm, or, as shown at D, of a photographic film suitably exposed, developed and fixed,

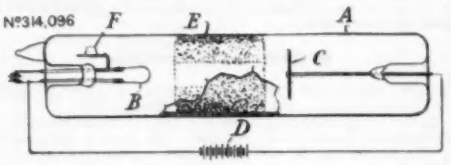


the film having maximum transmission of light at one end and minimum transmission at the other. The apparatus is calibrated by placing a light of known intensity, say, 1 foot-candle, before it and adjusting the film on its rollers until the instrument C registers a definite deflection, say, the half-scale deflection marked 1. The film at this point is marked "1 foot-candle." The known intensity of light is then altered to 2 foot-candles, and the film readjusted until the instrument C again registers the half-scale deflection. The film at this point is then marked "2 foot-candles." This process is repeated until the filtering film is completely calibrated. When an unknown light intensity is being measured, the film is adjusted until the instrument C indicates the half-scale deflection. The candle-power is then read directly off the film. In all cases the amount of light actually falling on the photo-electric cell is substantially constant. That cell can, therefore, be set to operate at that point of its characteristic curve at which the change of current for a given change of light intensity has its maximum value. In the third diagram the photo-electric cell is shown connected to the grid of a three-electrode amplifying valve. By this arrangement large-scale deflections of the instrument C can be obtained for very low intensities of light.—*September 17th*, 1930.

MISCELLANEOUS.

314,096. June 22nd, 1929.—Improvements in Light-sensitive Discharge Apparatus, The British Thomson-Houston Company, Ltd., Aldwych, London, W.C. 2.

The basis of this improved form of photo-electric cell is the discovery that the control of the thermionic current in such a cell is substantially increased if the light-sensitive layer is exceedingly thin; for example, if it is of monatomic thickness. The thoroughly evacuated glass, or quartz, envelope A contains an electron-emitting filamentary cathode B, consisting, for example, of nickel or platinum as a foundation with a barium oxide coating, or a coating of alternate layers of barium oxide and strontium oxide. The anode C may be a disc of nickel or molybdenum. A relatively high-potential battery D provides an electrostatic field between the electrodes. The element controlling the electron stream between the cathode and the anode is indicated at E. It consists of a foundation layer of silver, chemically or electrically deposited, and having a clear space or window formed in it at one point for the admission of the controlling light governing the operation of the cell. On this layer of silver there is deposited a monatomic film of photo-sensitive material; that is to say, a material which, when activated by light, emits electrons at a density proportional to the amount of light falling on it. This material may be



caesium or rubidium. It is deposited on the silver foundation by fixing a pellet of, say, caesium dichromate and silicon inside the envelope, as at F, and causing it to yield pure caesium vapour by the action of high-frequency induced currents. This vapour it is found condenses on the silver film in an exceedingly thin layer. The excess vapour is removed by means of the exhausting pump. The low temperature at which the cathode emits its electrons is claimed not only to enhance the life of the light-sensitive element, but to result in the light emitted from the cathode having no effect on that element, the action of which is solely dependent upon the external light falling upon it. It is stated that this form of cell has given a photo-electric amplification factor as high as ten.—*September 22nd*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Chemical Engineers.—At the Institution of Civil Engineers, Great George-street, S.W. 1. "High-pressure Reactions," by Professor W. A. Bone, F.R.S. 6.30 p.m.

Institution of Electrical Engineers: London Students' Section.—Victoria Embankment, London, W.C. 2. "Is the Engineer of To-day Making the Best Use of His Opportunities in Electrical Development in this Country?" by Mr. H. T. Young. 7 p.m.

Institution of Electrical Engineers: North-Eastern Students' Section.—Visit to the Consett Ironworks. A special omnibus will leave Worswick-street, the Northern Bus Strand, Newcastle-on-Tyne, at 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Informal meeting. "The Two-stroke Engine," by Mr. E. T. Westbury. 7.30 p.m.

Overhead Lines Association.—Annual conversazione.

SATURDAY, NOVEMBER 1st.

Institute of British Foundrymen: Lancashire Branch.—At the College of Technology, Sackville-street, Manchester. Open discussion on "Foundry Problems." 4 p.m.

MONDAY, NOVEMBER 3rd.

Bradford Engineering Society.—At the Technical College, Great Horton-road, Bradford. "The Construction of a Cinema," by Mr. W. Illingworth, illustrated by lantern slides. 7.30 p.m.

Railway Club.—57, Fetter-lane, London, E.C. 4. "Some Problems of Suburban Train Operation," by Mr. L. S. Sherwood. 7.30 p.m.

Society of Chemical Industry: London Section.—In the Rooms of the Chemical Society, Burlington House, W. 1. "Magnetic Susceptibility as a Means of Investigating Chemical Properties," by Professor J. F. Spencer; "The Mechanism of the Formation of Cellulose Nitrate and other Nitric Esters," by Dr. R. C. Farmer. 8 p.m.

Society of Engineers.—In the Apartments of the Geological Society, Burlington House, W. "The Measurement of Water," by Mr. H. B. Millard. 6 p.m.

TUESDAY, NOVEMBER 4th.

Co-ordinating Committee Representing Staffordshire Iron and Steel Institute, Birmingham Metallurgical Society (Inc.), Birmingham Local Section of the Institute of Metals.—In the Girls' High School, Dudley. "Steel for the Hollow-ware Trade," by Mr. G. R. Bolsover. 7 p.m.

Institute of Metals: North-East Coast Local Section.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Gases in Metals," by Mr. S. L. Archbutt. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Opening meeting. Address by Sir George William Humphreys, K.B.E., President, and presentation of medals awarded by the Council. 6 p.m.

Institution of Electrical Engineers: North Midland Students' Section.—At the Hotel Metropole, Leeds. Mr. I. H. Hedley, the Chairman for the session, will deliver his address. 7.30 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow, C. 2. "Manœuvring of Ships, Part IV.: Unbalanced Rudders Behind Twin-screw Ships: Effect of Varying Fullness of Form," by Mr. G. H. Bottomley. 7.30 p.m.

WEDNESDAY, NOVEMBER 5th.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section. Address by Mr. C. E. Rickard. 6 p.m.

Institution of Heating and Ventilating Engineers.—Swedenborg Hall, 20, Hart-street, Bloomsbury, W.C. 1 (entrance in Barter-street). "The Operation of the Heat Pump and its Possible Application to Heating Problems, particularly Swimming Bath Heating," by Mr. T. G. N. Haldane. 7 p.m.

Institution of Sanitary Engineers.—Holborn Restaurant, London, W.C. Annual dinner. 7 p.m.

Liverpool Engineering Society.—9, The Temple, 24, Dale-street, Liverpool. "The Application of Electro-deposited Metals to Marine Engineering," by Mr. C. H. Faris. 6.30 p.m.

THURSDAY, NOVEMBER 6th.

British Association of Refrigeration.—At the Institution of Mechanical Engineers, St. James's Park, London, S.W. 1. "The Use of Reversed Cycle Heat Engines of the Refrigerator Type for Heating Purposes, particularly the Heating of Swimming Baths," by Mr. L. Chew and Mr. G. T. N. Haldane. 5.30 p.m.

Institution of Electrical Engineers.—In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. "The Cooling of Electrical Machines," by Mr. D. B. Hoseason. 6 p.m.

FRIDAY, NOVEMBER 7th.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Thomas Hawksley Lecture, "The Machinery of the Earth," by Professor J. W. Gregory, F.R.S. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "Luminous Electric Tubes (Neon, Helium)," by Mr. H. Marryat. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—In Lecture Theatre of Mining Institute, Newcastle-on-Tyne. "Feed Water Systems for Steam Installations," by Mr. R. W. Allen. 6 p.m.

MONDAY, NOVEMBER 10th.

Institute of Metals: Scottish Local Section.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "The Applications of High-nickel, Nickel-copper Alloys and Pure Nickel in Industry," by Mr. N. C. Marples. 7.30 p.m.

TUESDAY, NOVEMBER 11th.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—In the Municipal College, Ormerod-road, Burnley. "Some of the Aims and Objects of the Institute of British Foundrymen," by Mr. R. W. Stubbs. 7.15 p.m.

Institute of Metals: Swansea Local Section.—At the Y.M.C.A., Swansea. "Alloys: Some Reasons for their Composition," by Mr. H. W. Brownsdon. 6.15 p.m.

WEDNESDAY to SATURDAY, NOVEMBER 12th to 22nd.

South Wales Institute of Engineering.—Drill Hall, Dumfries-place, Cardiff. Exhibition.

THURSDAY, NOVEMBER 13th.

British Science Guild.—In the Goldsmiths' Hall, Foster-lane, E.C. The Sixth Annual Norman Lockyer Lecture, "Science and Modern Industry," by Professor Sir William Pope, F.R.S. 4.30 p.m.

Institute of Metals: Birmingham Local Section.—In the Chamber of Commerce, New-street, Birmingham. Discussion on "Metals and Alloys of the Future," to be opened by Dr. W. H. Hatfield. 7 p.m.

FRIDAY, NOVEMBER 14th.

Chadwick Public Lectures.—Lecture Room of the Royal Institute of British Architects, 9, Conduit-street, W. 1. "The Object and Methods of Sewage Treatment, particularly in relation to Inland Towns and Isolated Institutions," by Mr. J. H. Coste. 8.15 p.m.

Chemical Engineering Group.—Abbey House, Victoria-street, Westminster, London, S.W. 1. Joint Meeting with Newcastle Section. 3.50 p.m., visit to the Carville Power Station of the Newcastle-upon-Tyne Electric Suppy Company, Ltd.; 6.30 p.m., joint meeting in Armstrong College, Newcastle. "Caustic Embrittlement," by Mr. W. S. Coates. 8 p.m., informal dinner.

Institute of Metals: Sheffield Local Section.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Unsoundness in Metals," by Mr. H. Hyman. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Annual general meeting and election of officers. 7.30 p.m.

SATURDAY, NOVEMBER 15th.

Institution of Municipal and County Engineers.—South-Eastern District meeting at Heathfield. 11.45 a.m., assemble at Heathfield Station; 12 noon, proceed to Outfall Works of Heathfield Main Drainage and Sewerage Disposal Works; 2 p.m., luncheon at the Railway Hotel, followed by discussion on the papers: "Some Rural Difficulties," by Mr. W. O. Humphery; "Practical Notes on Supervision," by Mr. G. H. Ockenden.

TUESDAY, NOVEMBER 18th.

Institution of Electrical Engineers: Scottish Centre.—The annual dinner will be held at the Central Station Hotel, Glasgow. 6.30 for 7 p.m.

WEDNESDAY, NOVEMBER 19th.

Institution of Municipal and County Engineers.—At the Public Health Congress, Royal Agricultural Hall, Islington. "Modern Treatment and Disposal of Sewage, especially as Affecting Trade Wastes," by Mr. T. P. Francis. 11 a.m.

THURSDAY, NOVEMBER 20th.

British Waterworks Association.—Agricultural Hall, Islington, London, N.1. Winter session. "The Afforestation of Watersheds," by Mr. R. L. Robinson; "The Land Drainage Act, 1930, in Relation to Rivers Pollution Prevention," by Mr. A. Bebbington; "The Rural Water Supply Problem," by Mr. Douglas F. Worger. 2.30 p.m.

Institute of Metals: London Local Section.—At the Royal School of Mines, South Kensington, S.W. 7. "Some Non-ferrous Metals in Chemical Engineering," by Mr. Richard Seligman. 8 p.m.

FRIDAY, NOVEMBER 21st.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Ancient Clocks and Horological Curiosities," by Mr. R. P. Howgrave Graham, illustrated by slides and exhibits. 7.30 p.m.

MONDAY, NOVEMBER 24th.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. Cantor Lecture, "Modern Domestic Scientific Appliances," by Professor C. R. Darling. 8 p.m.

TUESDAY, NOVEMBER 25th.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. "The Development of Air Communication in Africa," by Mr. G. E. Woods Humphery. 4.30 p.m.

WEDNESDAY, NOVEMBER 26th.

Newcomen Society.—Caxton Hall, Westminster, S.W. 1. Annual general meeting. "Early Fire Extinguishing Engines," by Mr. Rhys Jenkins. 5.30 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. "The Chemical Constitution of Coal," by Professor W. A. Bone, F.R.S. 8 p.m.